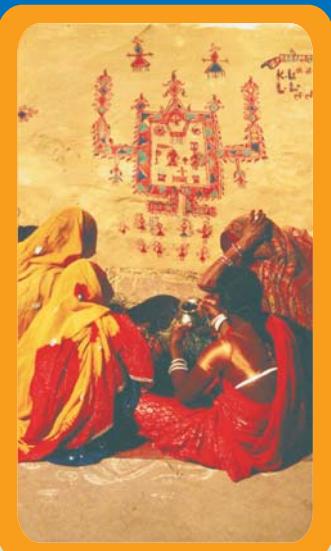
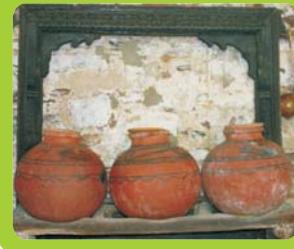
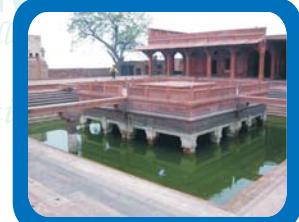




Water Challenges & Solution



इमं मे वरण श्रुद्धि हृवमद्या च मूळय । त्वामवस्युरा चके ॥



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वर्तमान में जल संकट क्यों?

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- वर्षा के दिनों तथा वर्षा की मात्रा में कमी
- कुओं/नलकूपों द्वारा अन्धाधुन्ध दोहन
- परम्परागत जल स्रोतों की उपेक्षा



अत्यधिक भूजल दोहन से उत्पन्न समस्याएं



- भू जल स्तर में गिरावट
- भू जल की गुणवत्ता में कमी
- ऊर्जा खपत में बढ़ोत्तरी
- कुओं एवं नलकूपों का सूख जाना
- कुओं को गहरा करने में अधिक खर्च

करें तो क्या करें?

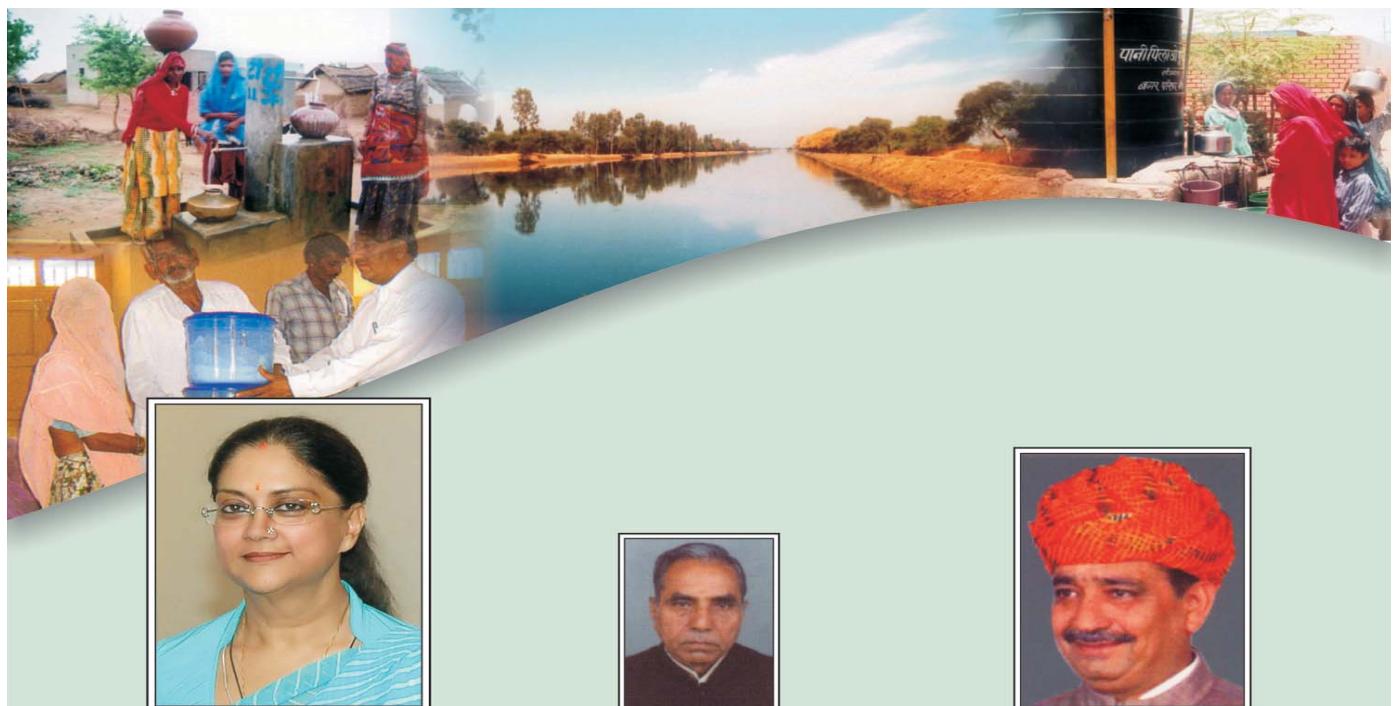
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- सड़क पर बहने वाले वर्षा जल से भू जल पुनर्भरण
- जल की कम खपत वाली फसलों की बुवाई
- बूँद-बूँद सिंचाई और फव्वारा पद्धति द्वारा सिंचाई करना
- परम्परागत जल स्रोतों का जीर्णोद्धार



परिणाम



- भू जल स्तर का ऊपर उठना
- भू जल की गुणवत्ता में सुधार
- भू जल की अधिक समय तक उपलब्धता
- कुआ गहरा करने में खर्च एवं ऊर्जा की बचत



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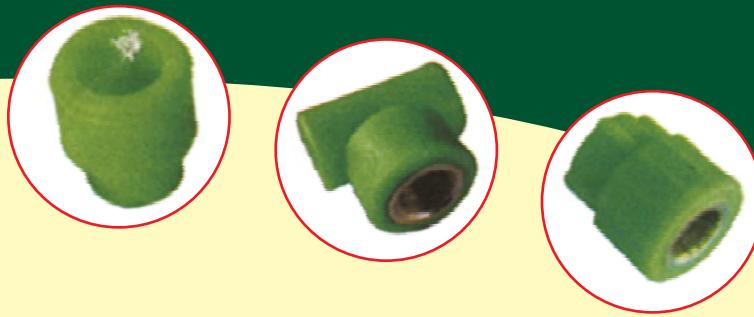
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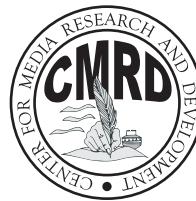
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Water Challenges & Solution

Editor
Surendra Chaturvedi



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अपनी बात

सर्वसुलभ पानी कितना दुर्लभ है, यह जानना हो तो पानी के क्षेत्र में काम करने वाले विद्वतजनों के पास बैठना पड़ेगा। सेंटर फॉर मीडिया रिसर्च एंड डिवलपमेंट के तत्वावधान में जयपुर में 29 व 30 सितम्बर 2007 को पानी की चुनौतियां एवं समाधान विषय पर जुटे पानी पारखियों के साथ रहकर लगा कि पानी के अवमूल्यन ने उनकी जिदंगी में पानी के संरक्षण के लिए लड़ने का मादा पैदा कर दिया है। वे इतने जुझारू हैं कि अपना सर्वस्व लगाकर समाज में पानी के लिये अलख जगा रहे हैं।

दो दिनी इस कार्यशाला का इसलिए भी महत्व बढ़ जाता है कि इसमें भाग लेने के लिए देश भर से 250 से भी अधिक पानी पारखी एकत्र हुए, जो नहीं आ पाए उनकी निगाह इस आयोजन पर टिकी रही। आमतौर पर इस तरह के आयोजन किसी संकल्प और प्रस्ताव के साथ समाप्त होते हैं, यह कार्यशाला इस चुनौती के साथ समाप्त हुई कि पानी के संरक्षण के लिए हम वर्तमान पीढ़ी के साथ-साथ आने वाली पीढ़ी को भी तैयार करें। उन्हें पानी का मूल्य बताएं, उन्हें पानी की महत्ता के बारे में शिक्षित करें और साथ ही शुरूआत करें ऐसी पत्रकारिता की भी, जो पानी की विघटन क्षमता के बजाए उसकी संयोजन क्षमता पर केंद्रित हो।

सेंटर फॉर मीडिया रिसर्च एंड डिवलपमेंट का यह प्रयास अपने उद्देश्यों पर कितना खरा उतरा, इसका फैसला तो समय करेगा, परन्तु इतना निश्चित है कि पानी की यह पतली धार प्रबल वेग से बहने वाली नदी की शुरूआत है। इस कार्यशाला में भाग लेने आए विशेषज्ञों के विचार इस पुस्तक में लेख के रूप में प्रकाशित किए जा रहे हैं। इसके अलावा अन्य स्त्रोतों से भी जो जानकारी हमें मिल पाई, उसका भी हमने उपयोग किया है। इन सबके पीछे सिर्फ इतना सा हेतु है कि समाज को पानी के बारे में उपयोगी एवं प्रमाणिक जानकारी मिल सके।

अंत में हम उन सभी के आभारी हैं जिनके सहयोग से सेंटर फॉर मीडिया रिसर्च एंड डिवलपमेंट का यह प्रयास सफल हो सका।

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सचिव

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Two Day Symposium

Water Challenges and Solutions

■ S. D. BHARTI



S. D. BHARTI

A two day symposium, Water: challenges and Solutions, was organized by Centre for Media Research & Development (CMRD) in association Indian Water Works Association

(IWWA) on 29th & 30th Sept. 2007 at Bhagwat Singh Mehta Auditorium, HCM RIPA (OTS), Jaipur. The symposium was supported by UNICEF, Dept. of Water Resource GOR & Municipal Corporation Jaipur. The conference was able to underline the importance of water in life & the role of people to manage this precious resource with special reference to Rajasthan. The program was divided in four technical session (copy of the program enclosed). In all more than two hundred delegates attended the deliberations (list enclosed) moreover, delegates from Gujarat, Maharashtra, Delhi and Haryana also participated.

The symposium was inaugurated by renowned social thinker and statesman sh. Mahesh Sharma. He expressed that we are lucky to have perennial rivers originating from the mighty Himalayas, despite that our forefathers gave divine place to our rivers. Today the entire world is facing water problems, son under such circumstances it is our moral responsibility to teach the world the philosophy of common good. Presiding over the function sh. Shree Padre, a renowned social activist & Journalist from Kerala, underlined the work done for water management in Rajasthan by traditional methods. However, he urged the need to extend it further so as to reach to everyone and to create a water culture. For this a strong role for the "water journalism" was realized.

The symposium was organized in four sessions. The first session was jointly chaired by Sh. Ratan Singh, CE, PHED, Rajasthan and Prof. Y.P. Mathur, Dept. of Civil Engg. MNIT Jaipur. The key note



lecture was delivered by Dr. M. S. Rathore, Institute of Development Studies, Jaipur. Dr. Rathore spoke about the anachronistic nature of our water laws which are now out of context as well. He emphasized the need to give predominant role to the people for sustainable water management. Second speaker of the session, Sh. C. M. Tejawat, Command Area Development (CAD), Kota, underlined the vital role of participatory irrigation management as more than eighty five percent of water consumption is in the agriculture sector. He also spoke about the need to train the cultivators for practicing cultivation under water scarcity. Third speaker of the session, Sh. Damodar Sharma, DG, Indira Gandhi Panchayati Raj Sansthan, Jaipur, gave interesting information about Water shed Development programs and its significant contribution water soil and water conservation eventual leading to social and economic status of cultivators. Fourth speaker, Shashtri Koseendra Das, JNU Delhi, described the divine description of water in Sanskrit literature and need to bring it to the knowledge of everyone. Another Speaker, Sh. Hemant Joshi, director, CCDU, emphasized the role of sanitation and the strong need to give due importance to it for proper hygienic environment. Sh. Mahesh Panpalia of Dhara Sansthan, told to the

Panpalia of Dhara Sansthan, told to the audience about the work done by their organization in Bharmer for water conservation. In the end, session summary



was presented by Sh. Ratan Singh, he also told about various governmental efforts to ensure safe drinking water to all despite diverse and adverse conditions prevailing in



the state.

Indira Gandhi Panchayati Raj Sansthan, Jaipur, gave interesting information about Water shed Development programs and its significant contribution water soil and water conservation eventual leading to social and economic status of cultivators. Fourth speaker, Ratan Singh, he also told about various governmental efforts to ensure safe drinking water to all despite diverse and adverse conditions prevailing in the state.

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The second technical session was chaired by Prof. Damodar Sharma, vice chancellor, Rajasthan Technological University, Kota, Prof. Y. P. Mathur, Dept. of Civil Engg. MNIT Jaipur, delivered the keynote speech, he underlined the significant role of ground water recharge and strong need to develop and use cost economic techniques of ground water recharge. Second speaker of the session, Dr. D. D. Ojha emphasized the need to add water as a teaching subject in the regular curriculum for generating awareness. Prof. K. K. Sharma of Ajmer University mentioned about the huge wastage of water

in industry and laboratories, he showed the techniques of water saving in Industry. Sh. L. N. Mathur of Rajasthan Ground Water Department opined about the imminent dangers of fast depleting ground water table in Rajasthan. He showed the viable techniques of ground recharge with reference to Jaipur. In the end session summary was presented by the session chairperson. In the evening a magnificent cultural evening was organized followed by sumptuous dinner.

fast depleting ground water table in Rajasthan. He showed the viable techniques of ground recharge with reference to Jaipur. In the end session summary was presented by the session chairperson. In the evening a magnificent cultural evening was organized followed by sumptuous dinner.

First session of day two was jointly chaired by Prof Manohar Kalra, vice chancellor, Kota University, Sh. Rajendra singh, well known water activist and Magasaysay awardee and Advocate Aruneshwer Gupta, additional advocate general of Rajasthan. Delivering the key note speech, Sh. Singh talked about the present day challengers of water that includes- corporatization of water, diminishing role of people and dominant role played by the State leading to dangerous consequences. He emphasized the need to look towards our traditional methods of water management and dominant role to the people for everlasting development. Another speaker Sh. R. M. Mathur of Irrigation department, briefed about the overall water resources scenario in Rajasthan and various governmental efforts to augment the water availability. He opined the limited usefulness of people's participation for only small scale and indispensability of State for larger schemes

for the overall benefit of the people. Further, Sh. O. P. Mathur, an agronomist by profession, gave a live and practical example of roof top water harvesting practiced, and also urged the indispensability as well feasibility of roof top water harvesting in urban environments. Dr. Ajay Verma of R. R. College Alwar, underlined the role of religion to keep the water clean, similarly, Prof. K. K. Shukla, advised to alter various ritual in order to keep the water clean and free from pollution.

harvesting practiced, and also urged the indispensability as well feasibility of roof top water harvesting in urban environments. Dr. Ajay Verma of R. R. College Alwar, underlined the role of religion to keep the water clean, similarly, Prof. K. K. Shukla, advised to alter various ritual in order to keep the water clean and free from pollution.

Second session of day two was chaired by Dr. Bharat Patak of Deen Dayal Research Institute, New Delhi. Delivering the key note talk Sh. Aruneshwer, spoke about the complex nature of inter-state-water disputes and the constitutional and legal position on the matters putting things in historical perspective. Dr. Vinita Gupta of Delhi University, talked about the efforts undertaken by women for water conservation and drudgery suffered by women folk in rural India to fetch water. Sh. Subhash Sharma, Yavatmal (Maharastra) gave the practical and live example (through pictures) of water conservation practices followed by him with great success in the dry regions of Maharastra. Sh. Mayank Misra of Gram Chetna Kendra told about the efforts undertaken by their organization for water conservation. In the end of the session a lively panel discussion cum open session was organized, which was anchored by Prof. Kalra, vice chancellor, Kota University. The panelist unanimously agreed to give predominant role to the people for sustainable water management and a strong need to adopt location specific cultivation practices. The panelist gave answers to various complex questions raised by the audience in a candid manner.

In the end the valedictory session was held with renowned social thinker sh. Govind Acharya as the main speaker. Sh. Govind ji, in his characteristic style talked about the limitation of State apparatus and huge utility of social apparatus to handle the issue of water. He also warned about the dangers of commercialization of water in the emerging market place and diminishing role of social institutions. ■

***Author is Co-ordinator of this programme**

Inauguration



Renowned Thinker Dr. Mahesh Sharma Addressing in Inaugural Session of Two Day's Symposium on Water : Challenges & Solution Held at HCM, RIPA on 29th & 30th September 2007



**Kalash Pujan by :
Dr. Mahesh Sharma**



**Pujan by:
Shree Padre, Waterman of India**



**Welcome Speech by:
Sh. Devi Singh**



**Keynote Address by:
Shree Padre**



**Subject Introduction by:
Surendra Chaturvedi**



Sh. Ajay Pal Singh Chairman RHB



Picture of First Session



Time for Food

PAPER PRESENTATION



Prof. M.S. Rathore
IDS, JAIPUR



Sh. C.M. Tejawat
CAD, Kota



Sh. Damodar Sharma
D.G. IGPRS



Taking Notes



Shastri Koslenderdas
Research Scholar



Dr. L.N. Mathur
CGWDB, GOI



Dr. K.K. Sharma
MDS University, Ajmer



Sh. Hemant Joshi
Director CCDU



My Question



My Question



Dr. Ajay Verma
RR Collage, ALWAR



Sh. S.D. Bharti
MNIT, JAIPUR



Dr. Y.P. Mathur
MNIT, JAIPUR

PAPER PRESENTATION



Sh. Damodar Sharma VC, Tech. University of Raj.



Sh. Manohar Kalra VC, University of Kota



Sh. Jogewshwar Garg, MLA



Dr. Bharat Pathak Sec. DRI, Chitrakoot (M.P.)



Dr. M.K. Shrimali, MNIT, JAIPUR



Sh. O.P. Goyal, Convener
Retd. CE, PHED



Sh. Aruneshwar Gupta,
Additional Advocate General GOR



Sh. O.P. Mathur, JAIPUR



Sh. G. R. Gupta, Addl. CE, PHED, JAIPUR



Sh. Subhash Sharma, Yawatmal (Mah.)



Sh. D.D. Ojha, Jodhpur



Smt. Vinita Gupta, Delhi



Sh. M.M. Mishra, JAIPUR



My Question

WELCOME & MOMENTO PRESENTATION



Welcome Sh. Rajendra Singh
Renowned Water Activist



Ashok Parnami, Mayor JAIPUR
Welcomes Sh. K.N. Govindacharya



Sh. Damodar Sharma
VC, Tec. Univ. of Raj.



Momento Presentation
to Sh. Aruneshwar Gupta



Momento Presentation
to Sh. Jogeshwar Garg, MLA



Dr. Bharat Pathak
Sec. DRI Chitrakoot (MP)



Momento Presentation to
Sh. Manohar Kalra, VC University of Kota



Momento Presentation to
Sh. Y.P. Mathur, MNIT JAIPUR



Momento Presentation to
Sh. Damodar Sharma, DG, IGPRS



Welcome to Shree Padre,
Waterman of INDIA



Welcome to Dr. Mahesh Sharma
President BJP



Welcome to Sh. Gulab Chand Kataria
Home Minister of Rajasthan



Welcome to Sh. Madan Dilawar
Social Welfare Minister, GOR



Momento Presentation to
Smt. Rita Bhargav



Momento Presentation to
Sh. G,R, Gupta Addl. CE, PHED, GOR

Light Mood Moments



Sh. Govindacharya with CMRD Team



Sh. Rajender Singh & Sh. G.R. Gupta



Sh. Damodar Sharma & Dr. K.K. Chaturvedi



Delegates Going Through to Books



Sharing of Thoughts with Sh. Govindacharya



Delicious Lunch



Delicious Lunch

Cultural Evening



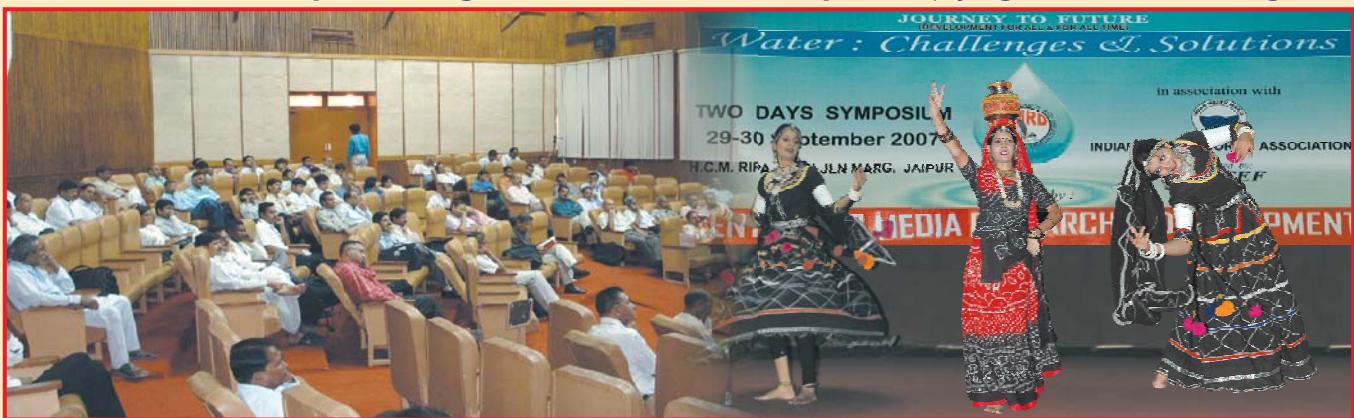
Chari Nritya by : Rajasthani Folk Artists



Kumar Narendra & Group Presenting "Geet for Jal"



Participants Enjoying the Cultural Evening



Participants Enjoying the Folk Colours of Rajasthan

Rainwater Harvesting

THE ONLY SUSTAINABLE SOLUTION TO WATER SCARCITY

■ SHREE PADRE



SHREE PADRE

Though there is relatively good rainfall in many parts of our country, we are facing water scarcity. Instead of counting the

water-scarce areas, it is easier to count areas where there is no water problem. In Chirrapunji in northeast that enjoys highest rainfall - 12,000 mm - in the country, water trading takes place in summer.

Our country has a great tradition of water conservation and rainwater harvesting. Even before Jesus Christ was born, there were examples of Rain water harvesting. Go to any part of the country, including the deserts of Rajasthan, our ancestors had built unique traditional water conservation systems. Unfortunately, many of them aren't still well-documented. We in India have enough examples and knowledge to teach water conservation to all the third world countries.

Take any religion in our country Hinduism, Sikhism, Buddhism and Islam etc. The holy texts of all these religions have held water with great respect. They describe it as sacred. But how we, the followers of these religions are treating water? We throw all our industrial wastes, human excreta etc



Rain water harvesting is just like operating your bank account. If you deposit the rainwater in mother earth's bank in monsoon, it acts like ATM in summer.

into the rivers and water bodies and think ourselves as wise. But we shouldn't forget that the very same jeevjal can turn mruthyuvahak, the agent of death, if we abuse it. There are many many examples in this country to illustrate this.

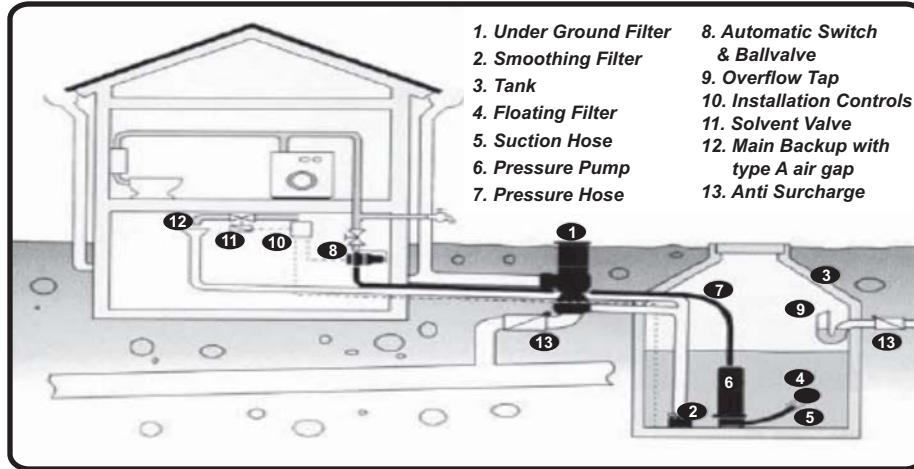
Rain is the primary or is the only source of water for most of the country. Earth is only a vessel. Even if there are good rains, it need not necessarily mean that there would be water till summer end. The moot question is: where has all the rainwater gone? The crux of the problem is that most of the rainwater runs to the sea even before fulfilling many of our needs.

As a result, we have to start looking up the sky in February or March itself. Reality is that the next supply of water, the monsoon can

start only in June next.

If rainwater has to percolate into the land, our water-vessel, there should be some barriers. In good olden days, the forests and Traditional Water Conservation Systems were performing this function silently. Since we have destroyed most of these, today, we ourselves have to consciously put rainwater into the mother earth's womb.

Rainwater harvesting is the only sustainable solution for water scarcity. Digging more bore wells, constructing big dams like the one at Narmada or river linking, river diversions aren't. Rain water harvesting is just like operating your bank account. If you deposit the rainwater in mother earth's bank in monsoon, it acts like ATM in summer.



If you carefully look back in the country, one main factor is noticeable in all our RWH success stories.

Wherever water sustainability is achieved, it is only be self-help or People's participation.

Wherever people carry out 'paani ka kaam' from heart, the results are always good and long-lasting.

There is a universally accepted golden rule of Rainwater Harvesting. 'Catch rain where it falls'. This is also known as in-situ Rainwater Harvesting. There are many advantages in following this rule. First and foremost, even poor people can afford to harvest rain. There is no necessity of bringing inputs like steel or cement from the cities.

On the other hand, if we try to catch rain after it flows quite a distance, we need more efforts. That means, we need cement, more money and require the help of engineers, help from administration etc.

Another root cause for our water scarcity is that we don't learn to calculate water, to understand the mathematics of water and its annual cycle. It is said wherever people treat rain as a headache, there will be water shortage. Rain is a great wealth. The rain that falls on our roofs and land today is our drinking water next year. We never care to calculate our expenditure - the water we use - and our income - the rain we get. Increasing the rainfall is not in our hands. But using all the water that falls on our land very carefully is in our control. Dr. Rajendra Singh who has done outstanding work in watershed

development here in Rajasthan suggests to use water a 'poor man's ghee'.

Generally, everybody complains about lesser rains. One question we never have posed so far is this: 'How much is the minimum rain required to run our lives smoothly?' In Khandwa, Madhya Pradesh, they did a study years ago. With the participation of local people, they drew a water budget. In the rural areas, there were only three heads of water consumption. For domestic use, for livestock and for agriculture. The annual rainfall there, as per records is 800 mm. They were surprised to note that if only 16% of these rains get percolated in the earth, their requirements would be met. But there are variations in rainfall. Whenever they get 500 to 600 mm, they required 25%.

Well, this is paper calculation. They wanted to crosscheck it. In some selected areas, they went for what they called as 'total water harvesting.' In simple terms, they didn't allow the rainwater to run beyond 10 metres. Before that one or the other RWH structure would catch it. In areas wherever they carried out this experiment, within one year, they could bid good-bye to water tankers.

An important lesson in RWH

is to give enough opportunity time for the rain to percolate. In a similar way, we should give sufficient time for communities to be convinced about this concept. In our country, there are enough lessons and success stories of RWH. The greatest challenge lies in creating awareness among people towards self help and in melting their mental blocks.

I would compare the process of community RWH to that of repainting a car. The actual painting process takes only few hours. But if that job has to be effective, one has to slog for days carrying out patch work, tinkering, leveling, etc.

Second important aspect to be noted is that RWH demands site-specific or location specific solutions. What is proved to be successful in Tamilnadu need not be so for Rajasthan. What is done in 'A's farm, if copied in the same way in 'B's farm too, need not necessarily yield fruits.

If you carefully look back in the country, one main factor is noticeable in all our RWH success stories. Wherever water sustainability is achieved, it is only be self-help or People's participation. Wherever people carry out 'paani ka kaam' from heart, the results are always good and long-lasting.

We shouldn't forget that we can not conserve only water in the nature. The cement or plastic jars are very limited. The biggest and cheap water vessel we have is the mother earth. So, if we have to save water, we have to save topsoil and forests too. There is an inseparable linkage between jal, jameen and jungle.

We should try to understand similar linkages water has with different aspects of human life. Say for example, one can impassionately say that 'groundwater level is decreasing by two feet every year.' But if you care to go to further depths you will learn more. The open wells might have gone dry. The monoblock pumps turn futile as bore wells and submersible pumps are required. Poor farmers in such a situation can't compete with the rich

and have to migrate subsequently.

Slowly the 'water market' starts raising its head, throwing all the human values to the air. With more and more bore wells going deeper and deeper quality of potable water suffers. Pumping costs raise up. Rabi crop turns to be dream. A new expenditure head for buying tanker water opens up even for poorest people, if they have o make a living.

Rajasthan has many lessons on water for the whole country. The way in which villagers in western Rajasthan live, I'm told, is a great lesson on water conservation. I would like to cite three very inspiring success stories your state has achieved. The first, Tarun Bharath Sangh, under the leadership of Dr.Rajendra Singh was able to give rebirth to five rivers, probably first time in the history. This was possible by rejuvenating the traditional johads and other waterworks of local communities. Second is the drought-proofing success of Lapodiya under Shri Lakshman Singh and his Gram Vikas Navyuvak Mandal Lapodiya. Even with an average of successive 300 to 450 mm of rainfall, they are leading a normal life by farming and animal husbandry, thanks to Shri Lakshman Singh's organisation skills, unique chauka system of soil and water conservation and the Ghir cattle. The third and recent enviable success is making the 17 km Nanduwal river in Ramghad block of Alwar district to flow again after two decades gap. This was a community action in which the local poor people have paid around 14 lakh rupees out of the total programme expenditure of 32 lakh Rs. This achievement by Shri Farhad Contractor and his organisation Sambhaav who are working with people has opened a fresh door of hope for all of us.

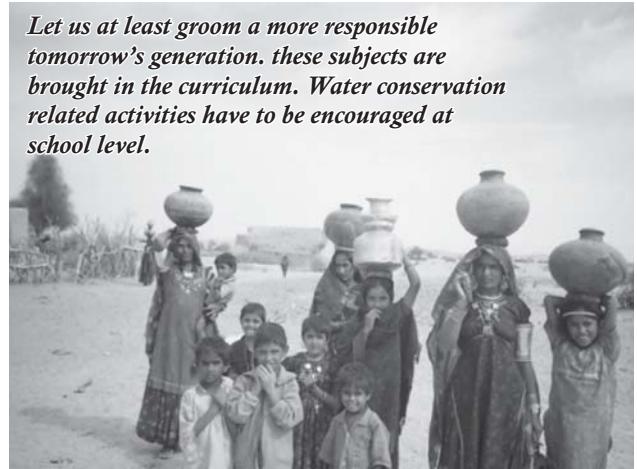
Students of water conservation should read two classics written by Shri Anupam Mishra - 'Rajasthan ki rajat boonein' and 'Ab bhi Khade hain talab'. Mishraji has held window to the wonderful

understanding of soil and water villagers in Rajasthan still have - a subject totally forgotten or not understood by our early historians.

We are running an unique farm monthly in Kannada, Adike Patrike since 20 years. Ours is the pioneering media effort to create mass awareness about RWH in Karnataka. When we started this in 1996, there were no success stories around. In other words, seeds of RWH were not available in our state. We got seeds from your Rajasthan, Gujarat and other severe drought-hit states and sowed it in the minds of our readers. After a decade, these seeds have grown into success stories in our areas. Now there are farmers who have revived streams, who have bid good-bye to their decades old water scarcity etc, all by self-help. We are really indebted to our brethren here in Rajasthan who have shown us he way.

Recently a Swiss gentleman, Toni Ruttiman visited our state. Though not an engineer, so far he has constructed 363 hanging bridges in Cambodia, Ecuador, Laos and Vietnam etc to help the war and earthquake victims without taking a penny. Each participating family has to give a bag of cement and labour. The bridges don't carry a name, board or logo of any institution. 'They are people's bridges. They themselves inaugurate it.', points out Toni, "whoever builds a bridge with his own hands, is not the same person anymore." People's participation inculcates a great sense of possibility, confidence and self-reliance in communities. That is what is most needed at the moment than government subsidies and ADB and World Bank loans. Toni had a question to me when I spoke to him. "Do you think building such bridges is possible anywhere in your country?" he asked.

Let us at least groom a more responsible tomorrow's generation, these subjects are brought in the curriculum. Water conservation related activities have to be encouraged at school level.



"People's minds are polluted with subsidies and petty politics. A state that has very conducive atmosphere for such self-help is Rajasthan", I replied Toni, "where by community efforts alone they are successful in making their lifeline - the river - to flow again."

Respected inaugurator of today's function Shri Mahesh Sharma was wishing that Bhageeraths have to take avatar for saving our people from water crisis. May I point out that you already have many in this state and what is left to us is to go there to see the work, understand the principles and to follow the same? Unfortunately, there is lot of communication gap. So much so that these good and inspiring achievements haven't reached many people who really matter in the State.

I am always insisting that subjects like RWH, sustainable farming and sustainable living should be incorporated in school syllabus. Elders don't seem to take such things seriously. Let us at least groom a more responsible tomorrow's generation. It's not suffice if these subjects are brought in the curriculum. Water conservation related activities have to be encouraged at school level. Our neighbor, Bangladesh, where arsenic problem in water is playing havoc with the lives of people, they have introduced these subjects in school syllabus in a very effective way. Why can't we? ■

*** (Author is Known as Waterman of India)**



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Recycling Water

A low cost automated recycling distillation technique saves gallons of water and gives better results

■ **K K SHARMA**



K K SHARMA

G l a s s distillation is c o m m o n l y used in almost a l l t h e laboratories all over the world for preparation of distilled water , plant

extraction and in many pharmaceutical processes. In the process of distillation vapors passing through the condenser tube are cooled and condensed by water flowing through condenser tube in the condenser unit of the apparatus. In almost all laboratories the water used for cooling the condenser tube is coming from the water supply tap near the wash basin. The precious water after circulating through the condenser tube is left into the drain as wastewater. It has been observed that about 40 liters of water is required for cooling for making 500 ml of distilled water. The water after cooling is generally left to go into the drain.

In a simple biological science laboratory about 2.5 liter of distilled water is used in a day which is a modest consumption. Approximately 200 liter water is required in cooling unit of distillation plant for this purpose. If this requirement is calculated for 25 working days in a month, the quantity of water wasted by one user in a month comes to about 5000 liters. In a big research laboratory or a unit of an institution or in a small industry where nearly 100 users are there, the amount of water wasted for cooling the condenser unit is estimated about

5,00,000 liters in a month .This is a big loss of potable water. In the present scenario of severe scarcity of drinking water all over the globe, we can not afford to waste such a large quantity of water during the process of distillation. Due to uncontrolled use and removal of ground water and insufficient rains in many parts of the world water is becoming day by day as an important natural resources. To overcome this problem of water loss in cooling during distillation Sharma (2004) invented a technique called recycling distillation technique in which water from the outlet tube of condenser Unit is collected , cooled and re circulated again in the condenser unit . The

technique not only saves gallons of water but also produce better results as far as condensation of vapors is



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Advantages of Condenser water recycling Technique

- i) The first and most advantageous aspect of his technique is to prevent waste of a precious natural resource particularly in those places where natural water supply is going down every year and drinking water is not available to meet out the supply of human beings.
- ii) The second advantage is that user is not dependent on tap water supply for cooling in condenser unit as in many laboratories particularly during summers tap water supply may not be available regularly and if water stops going to condenser tube through the tap it may over heat the condenser unit and can damage it.
- iii) Third advantage is that, during summers, tap water coming from the regular supply from overhead tank is very hot and it fails to cause effective cooling in condenser tube. This reduces speed of distillation. Since water collected in earthen pot place on moist soil filled in cement container, gets cooled before it is lifted to the condenser unit, the speed of condensation is enhanced even in summer months.
- iv) After attachment of recycling unit with condenser tube it is not needed to prepare distilled water near wash basin/sink or drain pipe. The modified distillation apparatus can be placed in any room without tap water supply or sink/wash basin or drain pipe.
- v) With this technique now it is possible to do low boiling liquid based plant extraction such as ether and other similar processes by supplying pre cooled water to the condenser unit.
- vi) Since efficiency of the system is enhanced, the modified technique saves lot of electrical energy also.

concerned.

The technique is based on a simple principle that is recycling water in condenser Unit. Sharma (2004) made some modifications in the existing distillation technique by introducing a collection, cooling and pumping devices to recycle water in the condenser tube again and again. The technique is low cost and very effective (fig.1). The water was cooled first by a simple indigenous cooling technique before it was allowed to enter again in condenser unit (recycling). Cooling technique involved collecting water from the outlet tube of the condenser unit in an earthen pot of about 50 litre capacity put on a cement container filled with wet sand. Once the water is filled in the earthen pot about $\frac{3}{4}$ of its capacity from the condenser unit it gets cooled. Then it is lifted to a reservoir tank of about 60 litre capacity placed at a height of 4 feet from the earthen pot, with the help of a small submersible motor placed in the earthen pot. (fig.1). The water lifting system has been made automatic by connecting an automatic water level controller with two relays in series. This has made the recycler fully automatic means whenever water level reaches to a definite height in the

earthen pot, the submersible motor switches on automatically by the water level controller. Reservoir tank can be used as plastic or earthen material depending on convenience. Cooling is more effective if reservoir tank is also an earthen pot. By this method hot water coming from condenser tube cool down in the earthen pot before it is lifted by submersible motor tank. The process of recycling water in the condenser tube goes on continuously and automatically.

This technique saves gallons of water of condenser cooling unit which otherwise go waste in the drain pipe. There is no effect in the quality of distilled water because cooling water in the condenser unit never comes in contact with water vapors. For a small distilled water apparatus (2-5 litre capacity flask) about 50 litres water initially filled in the reservoir tank for cooling the condenser unit can be used again and again for years by recycling it.

One of the advantages of this design is that existing distillation apparatus can be used for the installation of recycling unit and the total cost involved for this purpose comes to about Rs.300/- The technique is so simple that any user can install it with the existing distillation unit without any problem..

Another important application of this technique is that the distillation apparatus can be placed anywhere in the laboratory because this system does not require water supply from a tap or washbasin. Such water condenser water recycling device can also be attached to other plants/units such as distilleries, pharmaceutical industries etc where water is left in drain pipes after cooling the condenser unit.

The user can modify this technique as per the requirement for example connecting cooling earthen pot in series or connecting more than one distillation units with one recycling unit or fast cooling water in the earthen pot using ice cubes. Many researchers have found that by controlled cooling of circulating water by adding ice cubes in the earthen pot it has become possible to do low boiling liquids based plant extraction such as ether and other similar processes. According to them this was not possible earlier because water from the plastic tanks placed in open at the roof of building used to get very hot particularly during the summers. This used to decrease efficiency during the condensation. ■

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PIM In Rajasathan STATUS AND STRATEGIES



■ C.M.TEJAWAT



C.M. TEJAWAT

In the state of Rajasthan (India), as in many other states, Participatory Irrigation Management in different forms and using

different models has been tried since last 20 years and so. To provide legal support to the Farmers Organisation for the farmers' participation in management of irrigation systems in the state of Rajasthan an act titled The Rajasthan Farmers' Participation in Management of Irrigation Systems Act, 2000 has been enacted along-with

the rules (2002). The paper describes some of the important aspects of the legal framework and support provided to Farmers' Organizations for their sustainability. Out of the total irrigation potential created in the state which is about 3.2 million ha, about 850 Farmers Organizations have been so far constituted covering about 0.85 million ha irrigated area. As per guiding principles of state water policy and looking to the quite exciting experiences in the state it is planned to implement Participatory Irrigation Management in the remaining irrigation projects in near future. State has adopted slow & steady approach for transfer of irrigation system to beneficiaries instead of a bang-bang approach. The paper describes the status, policies and strategy to transfer the management of irrigation system

to the users in the Rajasthan, which is the biggest state in India.

Necessity of Farmers Participation

After independence large-scale construction of Irrigation projects under successive plans were taken up thereby increasing the irrigation potential of the Rajasthan from 0.40 million ha in 1951 to about 3.2 million ha at present. Due to several reasons created potential is not being utilised properly & large area remains unirrigated which a water deficient state like Rajasthan can not afford which is of size of 10.4% of the country's area having only 1.16% of the country's surface water resource.

The annual revenue realised from water charges is very less as compared to the non-plan expenditure

on Irrigation Organisation including establishment & interest on capital outlay. The state can hardly afford such heavy subsidy on irrigation sector. It is also clear that the State cannot find funds needed for the maintenance of the irrigation systems.

Due to inadequacy of maintenance funds & lack of proper practices of water management, the condition of the existing irrigation systems is going from bad to worse successively. Due to poor water management, the area in the command of irrigation projects is becoming increasingly waterlogged & saline & going out of cultivation.

In the irrigation projects constructed in successive plans, the construction above the canal outlets received attention whereas the design, construction & maintenance of irrigation system below the outlet did not receive proper attention except on some of the projects. This has caused lot of problems of over-outletting from canals, inefficient water use & wastage of precious water.

The Irrigation Systems are more administered than managed. Water users have no participation in administration of the Systems. They mostly depend on the irrigation agency for water supplies. A farmer is concerned with timeliness, adequate quantity & regularity of water supply to his field and advance information of the same to him. There is no incentive for economy in water & no deterrent against over-uses. This is not reflected even in the water rates, which are not on volumetric basis but on area basis. Canal offences & defaults being in excessively large numbers are hardly possible to be properly dealt with.

The above contributory factors have created under-performing irrigation systems, devoid of equity in water distribution between head & tails, strongly entrenched interests of those farmers who have opportunity to have excessive water supply at the cost of those who thus do not receive adequate supplies. Irrigation infrastructure is having widespread deterioration. Service to the farmers is poor & marked by insensitivity. Agriculture production per unit of

water & per unit of area is low.

There is thus an obvious need for paradigm shift, involving farmers in the management of irrigation system as a partner. It is experienced that when farmers participation is taken in the management of irrigation systems they have comparative advantages of:

- (i) Having better local knowledge of problems / fellow irrigators/ farmers' needs & irrigation problems.
- (ii) Having direct incentive to manage the system in productive manner,
- (iii) Better on-the-ground presence than even the most dedicated agency staff,
- (iv) Farmers greatly out number the irrigation agency staff & their properly harnessed management potential far exceeds the management potential of the irrigation agency.
- (v) Improved design construction, Operation & Management.
- (vi) Lower costs to Govt.
- (vii) Organised farmers for management of irrigation systems constitutes a social capital, which can have many off-spin advantages

Concept of PIM

Participatory Irrigation Management refers to involvement of water users in all aspects of irrigation management at all levels. "All Aspects" means initial planning, design construction, extension, improvement, renovation/modernisation, operation, maintenance, revenue assessment & recovery, supervision, financing, decision, rules, monitoring & evaluation. "All levels" means full physical limits of the irrigation system viz. quaternary, tertiary, secondary, main, project & sector levels as well as from lowest level function to the highest-level function including setting of policies. The participatory mechanism will include information sharing, consultations, joint

assessment, shared decision making, collaboration & empowerment of the water users. Farmers' participation can be involved by formation of Farmers Organisations (FOs) like Water Users Associations (WUAs), Distributary Committee and Project Committees.

PIM- EXPERIENCES

In the state of Rajasthan (India), as in many other states, Participatory Irrigation Management in different forms and using different models has been tried since last 20-30 years.

1. The Community Lift Irrigation Schemes (CLI) introduced in the early 1980s, focused mainly on lifting water from a suitable surface water source and its distribution through gravity flow to members of the community. After construction (with minimum 10% farmers contribution), these schemes were transferred to the WUAs for operation & maintenance.

2. The Irrigation Department and Irrigation Management & Training Institute, Kota with the help of USAID and Colorado University introduced four pilot WUAs in the 1980s in the Guda irrigation Project in Bundi District. The main objective of establishing WUAs was to involve farmers in irrigation canal management.

3. Command Area Development (CAD) programme was launched in the state during 1974 and Catchment Committees were established to promote a partnership between farmers and CAD officers for On Farm Development (OFD) works. Chack (area irrigated by single outlet) committees were also established to develop partnership between farmers and engineers to achieve two important PIM principles, namely to increase awareness among farmers about OFD, and to obtain farmers' support in checking the quality of physical works associated with OFD..

4. The Government of Rajasthan with the assistance of the World Bank launched a pilot program



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in 1992 under the Rajasthan Agricultural development Project (ADP) to transfer water distribution management to water users. Six irrigation projects, 2 minors each from a major and a medium project and two minor irrigation systems were selected as pilot projects. The first step of the pilot project was to organize farmers into WUAs and to involve them in deferred maintenance or canal rehabilitation. The second step was to hand over irrigation management at the minor level to WUAs. The WUA's main tasks were to take-over the O&M of canals and equitable distribution of water, and also to raise adequate funds from farmers to meet these objectives. The State Government also allowed each WUA to retain 50% of the irrigation charges collected.

5. WUAs were formed under the PIM activity of Command Area Development Program in an integrated approach combining

irrigation, OFD, agriculture extension and adaptive research. The main component of project were: (i) deferred maintenance and system rehabilitation of minor/distributory canal (the cost of rehabilitation has a ceiling of Rs. 3000 per ha of which 10% comes from the WUA), (ii) one time functional grant of Rs. 500 per ha in the ratio of Rs. 225:225:50 by the Central Government, State Government and WUAs respectively, (iii) action research, training of farmers and officials and monitoring and evaluation.

WUAs were registered under Rajasthan Co-operative Act 1965 and Rajasthan Societies Act 1958. WUAs carried out physical rehabilitation of irrigation infrastructure. The functional grant (managerial subsidy) was deposited in a fixed deposit account and its interest could be drawn by the WUA for annual maintenance work. The State Government also allowed each WUA to retain 50% of

the irrigation charges collected.

6. Under the PIM activity, whole Chambal Command Area (2,29,000 ha) has been divided into 359 WUAs, out of which 354 WUAs have been formed during 1992-1998. In absence of legal provisions for PIM at that time, these WUAs were registered under Rajasthan Co-operative Act 1965 (82 WUAs) and Rajasthan Societies Act 1958 (272 WUAs). Financial support was provided to these WUAs' through various agencies. Rehabilitation of canal system was done by 19 WUAs funded by NABARD worth Rs. 206.16 lacs. With RAJAD (Rajasthan Agricultural Drainage Research Project of Canadian International Development Agency) funds rehabilitation was done on one minor with Rs. 89.42 lacs. Under



construction of Irrigation projects under successive plans were taken up thereby increasing the irrigation potential of the Rajasthan from 0.40 million ha. in 1951 to about 3.2 million ha. at present

Agricultural Development Project (ADP) of World Bank, financial support @ Rs. 200 per ha was provided to 219 WUAs in addition to the rehabilitation of canals by 13 WUAs. Total fund under ADP was Rs. 402.42 lacs. Similarly, institutional support was provided to 33 WUAs @ Rs. 500 per ha with financial assistance from Ministry of Water Resources, State Govt. (45%: 45%) and farmer contribution (10%). Total Rs. 47.16 lacs was provided under state plan & central share.

The State Government also allowed each WUA to retain 50% of the irrigation charges collected and some of the WUAs have employed an unemployed youth (or retired knowledgeable person) to work as water master to assist WUA in maintenance of accounts, records, irrigation assessment, recovery of irrigation charges, conducting general body & managing committee meetings.

7. Four WUAs (one on each minor) were formed with 1618 ha culturable command area & 575 farmers, under the Action research Program (ARP) of IMTI, Kota during 1996. The program was based on PIM principles and lessons learned from previous experiments in WUAs and minimum rehabilitation in Rajasthan under the ADP. This was a mix of the

earlier two approaches of CAD & Irrigation Department.

The plan envisaged that farmers first should form into a WUA and register it under Cooperative Societies Act. Each member of the Cooperative has a share of Rs. 100. The WUA signs a Memorandum of Understanding (MOU) with the Irrigation Department promising that it would contribute 10% of the total estimated cost of rehabilitation.

Provisions of various works taken in the project reports (estimating to Rs. 39.25 lac) for the rehabilitation of all the four minors were also discussed with members of concerned WUAs and after giving due consideration to their own needs, some more works were also agreed to be executed. Considering above additional works and escalation (prevailing market rates), cost of all the rehabilitation works rose to Rs. 62.31 lac.

Execution of work was conducted by respective WUAs with technical support from irrigation department. With the completion of all the rehabilitation works, all relevant records of all the four minors including chak plans, canal operation plan and revenue record were handed over to the executive committee members of each minor along with the handing over of management of all the four minors, duly rehabilitated and brought to the designed standard to respective

WUAs for their operation, maintenance, assessment & recovery of irrigation charges.

8. Under World Bank financed Rajasthan Water Sector Restructuring Project (covering about 500,000 ha area) 506 WUAs were formed in 90 projects (major, medium and minor) as per the provision of The Rajasthan Farmers' Participation in Management of Irrigation Systems Act, 2000 (RFPMS). It was envisaged that these WUAs would, over time and in close coordination with the ID, take over the operation and management of surface irrigation system up to the distributary level. This is the largest project in the state that involves major rehabilitation of the irrigation system with WUAs major involvement. WUAs has been given the responsibility of rehabilitation of canals below 10 cusecs discharge.

9. Under JBIC (Japan Bank for International Cooperation) financed, Rajasthan Minor Irrigation Improvement Project it has been planned to constitute 415 WUAs for the same number of minor irrigation projects. This project is still under initial stage and formation of WUAs will commence very shortly.

10. At Narmada Project (1.34 lac CCA), where sprinkler irrigation system (along with a diggi for each outlet) has been proposed instead of gravity flow formation of WUAs has also begun. About 60 WUAs have been formed as per the provisions of RFPMS.

LEGAL SUPPORT

To provide legal support to the Farmers Organisation (FOs) for the farmers' participation in management of irrigation systems in Rajasthan an act titled The Rajasthan Farmers' Participation in Management of Irrigation Systems Act, 2000 was enacted and have come into force on and from 20th day of July, 2000. Rules 2002 has also been notified.

As per the act, the objects of the Farmers' Organisation shall be to promote and secure distribution of water among its users, adequate maintenance of the irrigation system, efficient and economical utilisation of water to optimise agricultural production, to protect the environment, and to ensure ecological balance by involving the farmers, inculcating a sense of ownership of the irrigation system in accordance with the water budget and the operational plan.

IMPLEMENTATION

The challenge of successful functioning of FOs and their sustainability can be met by ensuring; close partnership between the ID & AD officials and the farmers, equity in water distribution, proper maintenance plan, cultivating sense of ownership among farmers, transparency in functioning of WUAs and improved cost recovery and water service. For the implementation of PIM Programme in the state following points have to be considered:-

(a) Political Will

Political Will is very significant in a democratic institutional set up that prevalent in the Country. Wide reaching policy change can be implemented by only the political party in power. Main threat in Irrigation Sector reforms is tackling hardcore basic issues linked to irrigation sector reform like increase in water tax and restructuring / changing the mindset of dominant and all powerful irrigation bureaucracy. Farmers are spending 5 to 10 times money for irrigation water if it is drawn from tube wells, open wells or pumped from rivers etc. Farmers are interested in delivery of water at the assured time and right quantity. If they see this happening they are willing to pay more. By implementing PIM, irrigation charges can be increased easily.

Political will is just not sufficient

Political will is just not sufficient for one - time introduction of reforms. Reforms also have to be sustained for which a continues follow up is necessary.



for one - time introduction of reforms. Reforms also have to be sustained for which a continues follow up is necessary. This can only be achieved through constant political pressure. Traditionally, whenever there is a political lax seen, the bureaucracy used to its traditional functioning, perceives reforms as no more than some political gimmick and the entire spirit of the reform is killed.

New political leadership (FOs presidents) if conscious will also put pressure on the system to perform. For example these new leaders may put pressure on MLAs & M.P.S. to spend their funds for the irrigation system also.

(b) Legal Empowerment

RFPMIS Act 2000 alongwith Rules 2002 has been enforced in the state and WUAs have been formed as legal entities. Powers have been devoted to the WUAs, backed by legal rights & obligations. But still many amendments are essential in the Act & Rules. Hence before implementation of PIM programme in the state deliberations should be made so that necessary amendments required in the Act can be incorporated.

(c) Dept. to be facilitator

Large - scale irrigation systems have given rise to large and centralized bureaucracies. Over the years the

attitude of the irrigation department has become that of providers and even of owner. This has brought about certain arrogance in the department while dealing with the farmers, who are looked upon as recipients of the generosity heaped in to them by the department. The irrigation bureaucracy is resistant to any change, like many other administrative departments. One of the major fears for resisting change being that of losing powers and privileges.

They also have fear that if the FOs could not maintain the irrigation system properly it will come back on the shoulders of irrigation department & that's also in very bad shape. So, along-with a political will, there also has to be an administrative will for change and reforms.

The administrative will does not mean a few committed and highly motivated individuals at the highest level to change and try to force a change but a gradual attitudinal and behavioral change amongst all the ranks in the department. This is an easier said than done task. The most important actors are the Executive Engineer, Assistant Engineer and Junior Engineers who are responsible at the WUA level to believe in the reform process and they should believe that they are the facilitators for the WUA & not the commanding officer.

They should provide all the technical guidance & support to the

WUAs and boost their moral for the sustainability of the FOs. The attitude & behavioral change especially amongst the technical bureaucracy can be brought about by a series of training and awareness programs. Also a will and zeal amongst the higher-level officials will have a positive impact on lower level staff. Field interactions with the WUAs is also very important to have better relations amongst the irrigation staff and WUAs, which is also so far lagging. For the reform to take place smoothly following points must be considered:

- (i) There should be continuous training for all levels of staff regarding attitudinal & behavioral changes.
- (ii) Equal participation of farmers and engineers in the reform process.
- (iii) Least or no political interference in the role of engineers.
- (iv) Ensuring the feeling of security amongst officials.
- (v) Pick up committed officials to promote and guide the programme at the lower level.

(d) Mobilization of Financial Resources

One of the main reasons for government to introduce irrigation reforms has been the financial resource crunch the government is facing. Maximum portion of Budget allocated goes to administrative expenses (Salaries etc.) and negligible amount is spent for maintenance of irrigation system. Irrigation system is in very poor shape & it needs major rehabilitation, which is also deferred year by year due to shortage of funds.

Farmers also do not want to take charge of systems that are deteriorated or defunct and then assume full responsibility. Farmers fear that after transfer, the government will not provide any thing and they will have to pay irrigation charges (increased) but will not get the water, as the delivery systems are in very bad shape or need maintenance. Important point is that there should be commitment of

financial resources for the reform process i.e. basic O & M of the system before transfer or simultaneous with the transfer process. For the management of irrigation system (after transfer) the government should transfer all O & M funds from the department to the WUAs. Revenue department presently recovers irrigation charges, which were recovered previously by Irrigation department, and no provision exists for the funds to be allocated to FOs for maintenance of Irrigation system by them.

(e) Entrusting Powers to WUAs:

The basic foundation of the irrigation reform process is the Water Users Associations. If the WUAs are given sufficient powers they can sustain very well and will have following positive impacts:

- (i) Farmers will feel that they have an equal participation in management of irrigation system
- (ii) Quality of construction & maintenance will be improved
- (iii) Sense of ownership will be developed
- (iv) Water saving will increase irrigation efficiency
- (v) Better & timely availability of water will enhance crop production

(f) Priority for other Funds:

For areas where WUAs take over the management of canals and other PIM activities, the Government should give them a higher priority while sanctioning other development schemes of various government departments.

(g) Mass Awareness

Mass Awareness building and orientation, keeping in mind the apathy, indifference or even resistance to PIM at various levels not only in Govt. departments but also amongst farmers, large scale mass awareness building and capacity building

trainings about PIM and reorientation of thinking and approach is required for both farmers and Govt. functionaries; as also for all citizens in general. Extensive use of mass media should be made. Information, Education & communication activities should be taken up on large scale through Video/Audio Cassettes, TV, Radio Programme, News paper articles, pamphlets, leaflets, posters etc. For dissemination of knowledge to masses, education institutes may also be involved.

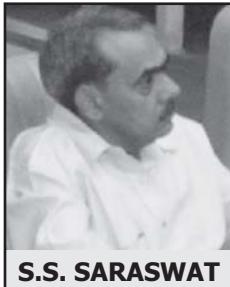
(h) PIM Directorate:

There should be a separate Directorate (as in M.P.) for monitoring and implementation of PIM programme under Water Resources or CAD&WU Secretary. The Director, PIM will directly report to the Secretary and will be responsible for policy making as well as implementation of PIM activity in the state. Director, should head the multidisciplinary PIM Cell, which should contain staff from the irrigation, agriculture, agricultural engineering, GWD & CAD Departments.

Divisional Commissioners, District Collectors, MLAs, MPs and Zila Pramukhs should be involved in motivating and orienting farmers so that PIM can be implemented on sustainable basis. Government employees used in the PIM programme will be required to work with extra dedication as champions of PIM. They should be provided with 'Special pay or a 'Project allowance''. State / District level awards should be provided to best FOs, who will collect maximum percentage of irrigation charges and has made efficient utilization of water.

*(Author is Assistant Director (Monitoring), CAD, Kota (Raj.)

Total Sanitation

■ S.S. SARASWAT**S.S. SARASWAT**

Sanitation and supply of drinking water are two very important aspects of rural development. Human health and hygiene largely depends on availability of safe drinking water and sanitation facilities.

availability of safe drinking water and sanitation facilities. There is a direct relationship in water, sanitation and human health. It is now evident that Eighty percent diseases are related to water and human excreta. In the developing and under developed countries unavailability of safe drinking water and lack of sanitation facilities causes several diseases and epidemics many a times and that is the reason of higher rate of infant, child and mother mortality in these countries. Situation in India is also not very different. As per ensure survey of 2001 only people of rural India had access to safe drinking water and only 22% had individual house hold toilets.

The Government of India started Central Rural Sanitation Programme (CRSP) in 1986 with a view to improve sanitation coverage. Emphasis in this programme was on construction of toilets. The programme did not yield desired results. An analysis of whole situation revealed the fact that the sanitation programme was not accepted by the people. It was for two reasons; first it was not their felt need and secondly they were not involved either in planning or implementation of the CRSP. Reacting to the lessons learnt from CRSP the Government policy underwent a paradigm shift and the Government of India decided to run the Rural Sanitation Programme as community based, people centered

and need based programme. Therefore in 1999 changed the Central Rural Sanitation Programme (CRSP) to 'Total Sanitation Campaign. Total Sanitation Campaign is a demand driven programme. Emphasis is on awareness generation and capacity building of the community so that people them selves realize the importance of sanitation. The objectives of Total Sanitation Campaign are as follows:

- (i) To bring about an improvement in the general life-style in rural areas
- (ii) To expand and accelerate the sanitation activities in rural areas
- (iii) To generate demand for sanitation facilities through awareness creation and education
- (iv) To impart health education and inculcate adequate cleanliness and hygiene habits among children in rural schools and child care centers.
- (v) To promote the low-cost relevant technology for sanitation facilities
- (vi) To convert dry latrines into water-flush toilets and abolish scavenging As the name indicates the goal of TSC is all round and sanitation practices. There are seven components of TSC. The main aspects of these components are as follows:

1. Safe Drinking Water

- A. Using clean and safe drinking water
- B. Taking care of the cleanliness around the source of drinking water
- C. Bringing water from source in a covered earthen pot
- D. Keeping the drinking water pot covered and at height from the ground
- E. Using a long Laddle to take out

- F. water from the earthen pot
- Adequate chlorination of water

2. Safe disposal of waste water

- A. Laying drains near water sources for disposal of water
- B. Using the water draining out of kitchen for gardening
- C. Recharging the under-ground water through a soak pit
- D. Linking the street drain with the main drains

3. Safe disposal of human excreta

- A. Eradication of open defecation : Every house to have a toilets
- B. Adopting low-cost alternatives of toilets
- C. Making use of single and double pit flush toilets
- D. Construction of Ventilated Improved Pit (VIP) toilets in dry areas

4. Disposal of solid waste

- A. Using the garbage bins
- B. Using the garbage pits for solid waste disposal
- C. Converting solid waste in manure and vermin-compost

5. Personal Hygiene

- A. Trimming nails once in a week
- B. Washing hands with soap before meals and after defecation
- C. Washing of hands by parents after washing the feces
- D. Taking daily bath
- E. Cleaning teeth and tongue daily
- F. Keeping hair clean and combing them
- G. Wearing a clean dress daily

6. Cleanliness of the House and Food

- A. Keeping the house and adjoining area clean
- B. Having enough windows in the house
- C. Washing hands with soap before cooking the food
- D. Washing thoroughly the

vegetables before cooking and fruit before eating

E. Keeping the food covered at all times.

F. Using a smoke less hearth/chulha for cooking

7. Community and village Cleanliness

A. Having a disposal pit in the backyard of the house

B. Keeping the area around the water sources clean

C. Making arrangements for the disposal of water through soak pits and drains

D. Keeping the public toilets, roads and drains clean

E. Planting trees to keep the environment clean and green

F. Constructing separate toilets for boys and girls in school and keeping them clean.

G. Constructing and maintaining child friendly sanitation facilities

Nirmal Gram awards

Government of India launched an award scheme for the Gram Panchayats which have attended a status of total sanitation viz fulfill all seven components of TSC of TSC. The award scheme was launched on 2nd October, 2003. There is a provision of award for the Panchayat Samiti and Districts also which have attended a status of total sanitation. Provision of award for individuals, NGOs and CBOs who have outstanding contribution in the field of rural sanitation is also there.

The details of award money in various heads in shown in the table below-

Particulars	Prize Money (In lac.)		
Gram Panchayat	0.50		
Block District	1.00		
Population Criteria Less than 1000	2.00		
1000 to 1999	4.00		
2000 to 4999	5.00		
5000 to 9999	10.00		
10000 and above Up to 50000	20.00		
50001 and above Up to 10 lakhs	30.00		
Above 10 lakhs	50.00		
Individuals (in Rs.)	0.10	0.20	0.30
Organisations other than PRIs	0.20	0.35	0.50

The Nirmal Gram Puraskar (awards) was started as an incentive to give a fillip to the Total Sanitation Campaign. The Government of Rajasthan has also announced parallel awards to the Gram Panchayats who win the Nirmal Gram Puraskar. The main provisions of these awards are as follows-

1. The Gram Panchayat receiving the Nirmal Gram Awards will receive the cash prize of Rs 1,00,000 from the State Government for the Development work.
2. If a panchayat samiti gets 10 and Zila parishad gets 30 or more Nirmal Gram Awards, will get the cash prizes of Rs 5,00,000 and Rs 10,00,000 respectively from the state government for development work.
3. If a Zila Parishad become eligible for the state award along with two Panchayat samitis receiving 10 awards each, the district will receive the cash prize of Rs 50,00,000.

Nirmal Gram is good strategy for implementing TSC also. Instead of spreading the resources in all Gram Panchayats of a district if intensive and concerted efforts are made in some selected potential Gram Panchayats then it is likely to yield better results. If a Gram Panchayat is awarded Nirmal Gram Puraskar then it is likely to become a source of inspiration and model for leaning for the neighboring Gram Panchayats in the area. This strategy is likely to succeed in Rajasthan also. In the last year twenty three Gram Panchayats received Nirmal Gram Puraskar from Rajasthan while this year more than twenty times applications have already been filed for Nirmal Gram Puraskar.

Constraints in TSC implementation and lessons learnt-

The Government of India has set the target to achieve total sanitation coverage in the country by 2012. But the programme has not received desired fillip as yet. A lot of efforts need to be to achieve the target. The basic constraint in implementation of

the programme is the mind set of people. They feel that it is always better to defecate in open away from home and they can't defecate in closed space. They are not aware about the evils of open defecation and their impact on health. The most sufferers of the lack of sanitation facilities are the women and they do not have much say in the house hold decisions. The topography of Rajasthan state is varied most of the part suffers from scarcity of water almost through out the year. There exists a perception among the people that construction of a toilet is a costly affair and that they can not afford this luxury. There is also a perception in the society that cleaning of toilet is a job mean nature and they should not do it.

Way forward

Accepting sanitation facilities by the masses involves a process of social change. This can not be brought about by way of enforcing law or simply of hardware and constructing toilets. There is a need to change the mind set and perception of the people and let them realize the cost they for medication of their kith and kin on account of illness due to diseases caused by contaminated water and open defecation. There fore we need to work closely with the community and make them aware about health and financial aspects sanitation. As it is a multi stake holder programme therefore there is a need for collaboration of Government agencies, NGOs, CBOs and PRIs. Strong and continuous IEC activities are required to be carried out in the field. The people need to be provided appropriate toilet options suiting to the geographical conditions. The delivery system needs to be strengthened and ensure that all the hardware and know how is available at the door steps of the beneficiary.

It appears to be an up hill task but the great revolutions are brought about by the people. What is necessary is that that they know 'what is to be done'.

*Author is consultant H.R.D. in CCDU, Jaipur)

Participation of Farmers FOR ITS OPTIMUM UTILIZATION

■ R. M. MATHUR



R. M. MATHUR

The state of Rajasthan is the largest state in the country covering an area of 0.342 Million Square Kilometer, which is more than 10 percent

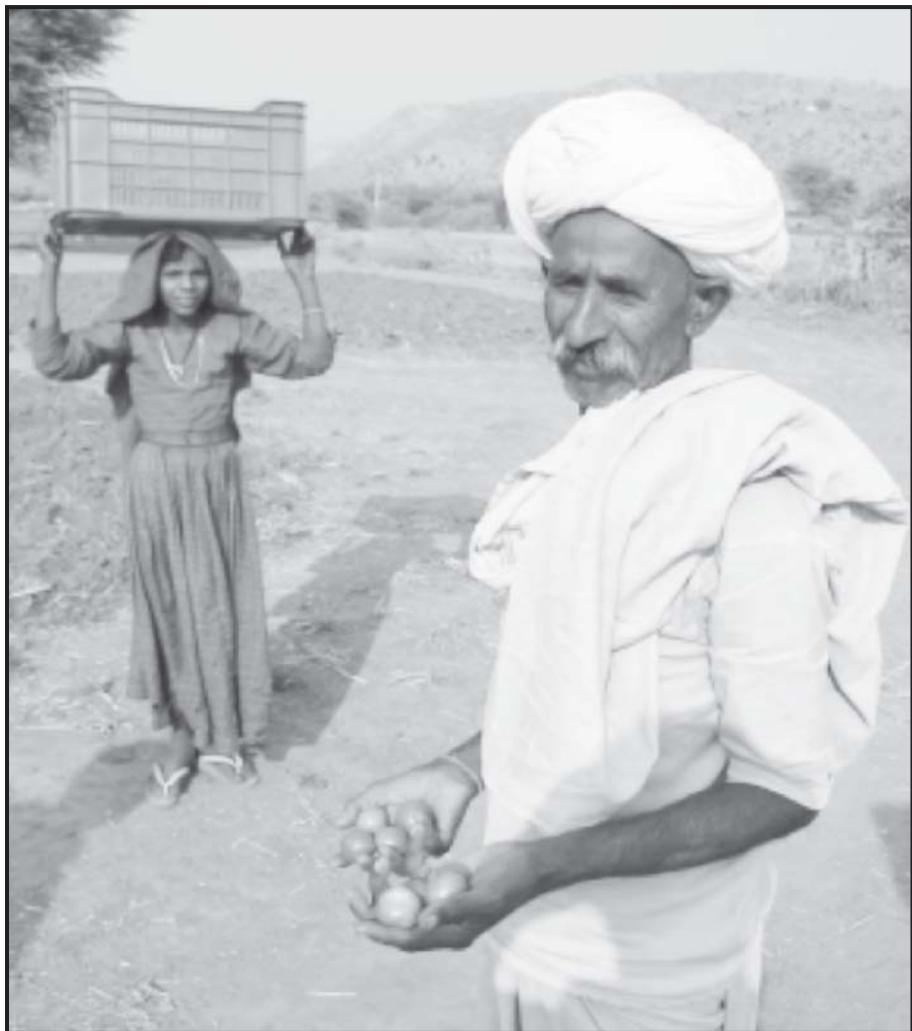
of the total geographical area of the country. About 5 percent of the total population of the country reside in the state and it has more than 15.7 Million hectare of land suitable for agriculture. Rajasthan is one of the driest states of the country and the total surface water resources in the state are only about 1 percent of the total surface water resources of the country. Aravalli range divides the state in two parts. In east of this range has distinct drainage while the area in the west of Aravalli range comprises of Thar Desert and do not have any drainage. The rivers of the state are rains fed and identified by 14 major river basins divided into 59 sub-basins. The surface water resources in the state are mainly confined to south and southeastern part of the state. There is a large area in western part of the state, which does not have any defined drainage basin. Thus the water resources in the state are not only scarce but have highly uneven distribution both in time and space. The surface water yield in 14 basins is computed as 21713.5 Million Cubic Meter (MCM) at 50 percent dependability (Water Planning Study of Rajasthan). The basin wise surface water availability is given in Annexure Table 1.

Interstate water

In addition to it Rajasthan has access to 17478 MCM water imported as per existing inter state agreements for share in Ravi-Beas, Sutlej, Narmada, Yamuna, and Mahi rivers.

It will be pertinent to note that the demand of water for irrigation, drinking water and various other uses can not be met from the total internal surface water sources. Rajasthan has

been striving hard for shares from the inter-State rivers namely Ravi, Beas, Sutlej, Chambal, Mahi, Yamuna, Narmada and Ganga. The first attempt for share in inter-State rivers (Ravi-Beas) was made by the erstwhile Maharaja of Bikaner as early as 1920 wherein water was allocated from these rivers for irrigation. Rajasthan after persistent pursuance with the adjacent States and the Government of India has been successful in getting



shares of waters allocated from various inter-State rivers as given in the Annexure Table

2. Inter Basin transfer of water

National water Development Agency (NWDA), a society under Ministry of Water Resources, Government of India is working to optimize the water use in the various river basins by computing the water balance of the basin and possibility of inter basin transfer of surplus water. The following two links will provide additional water to Rajasthan

Parvati – Kalisindh – Chambal – Banas link Sharda - Yamuna - Rajasthan - Sabarmati link

1 Parvati – Kalisindh – Chambal – Banas (PKCB) link

Under the peninsular component, NWDA have planned to harness the surplus water of Parwati, Newaj and Kalisindh river for irrigation requirements in Madhya Pradesh & Rajasthan after considering the water balance of these three rivers. A feasibility report has been prepared to link Parwati- Kalisindh- Chambal Rivers to utilize the surplus water of these rivers. The link will provide water in Rana Pratpsagar. This link will provide additional irrigation facility in 46000 Hectare in Rajasthan.

Sharda - Yamuna - Rajasthan - Sabarmati link

Sharada River originates from Indo- Tibetan boarder and is having entire catchment in Utter Pradesh. NWDA is working on a proposal, in which the 6972 MCM surplus water of Sharada River, is proposed to be used in Rajasthan, irrigating 7.79 lakh Hectare land.

Ground water

The position of ground water in the state is very critical. At present the annual recharge to the ground water is 10.38 BCM, while the annual withdrawal is 12.99 BCM, which is

125 percent of the annual recharge. This has resulted in depletion of ground water level in most of the 232 blocks. The comparison of status of ground water in these blocks in the different assessment years from 1984 to 2004 is given in table 1.

	1984	1998	2001	2002	2004
Safe	203	135	54	49	32
Semi Critical	10	34	32	21	14
Critical	11	26	65	80	50
Over exploitation	12	41	85	86	140
Salt affected	1	1	1	1	1

Table 1: Status of ground water level in 237 blocks Category Number of blocks in the assessment year

Rainfall in state

The average annual rainfall of the state is only 539.80 mm. This is nearly half of the average annual rainfall of the country. The Table 2 compares the average rainfall in the eastern part and western part of the state.

Table 2 : Average Rainfall in Rajasthan State

Particular	State average in mm	Average eastern part in mm	Average in western part in mm
1. Average of 100 Years	539.80	688.68	318.68
2. Maximum Rainfall	1079.49(1917)	1226.54(1917)	785.39(1917)
3. Minimum Rainfall	197.00(1918)	266.17(1905)	55.94(1918)

Table 2: Average Rainfall in Rajasthan State

Particulars State average Average in Average in in mm eastern part western part in mm in mm

The number of average rainy days in the state is also very less. This ranges between six in case of Jaisalmer district and 42 days in Jhalawar district. Rajasthan is facing continuous severe famine conditions in the past 10 years. The actual rainfall during last five years is Table 3:

Year	Normal (mm)	Actual (mm)	Percent deviation
2003	539.8	560.3	4% more
2004	539.8	493.5	9% less
2005	539.8	526.7	2% less
2006	539.8	670.3	24% more
2007	513.9	459.1	11% less

(up to September 15.07)

Table 3: Year wise rainfall in last 5 years

During the current year 2007, the monsoon is normal. The position of monsoon from June 1 to September 15, 2007 assessed by the Hydrology wing of Water Resource Department concludes as under:

Scanty rainfall i.e. (-) 60 % or less of normal rainfall in 0 district; Deficit rainfall i.e. (-) 20% to (-) 59% of normal rainfall in 12 districts; Normal rainfall i.e. (+) 19 % to (-) 19 % of normal rainfall in 15 districts; Excess rainfall i.e. (+) 20% to 59 % of normal rainfall in 5 district; Abnormal rainfall i.e. (+) 60 % or more of normal rainfall in nil district;

Affect of drought

The scanty rainfall and depletion of ground water has resulted in continuous draught conditions in Rajasthan. Very often draughts assume the form of calamity and the state have to struggle hard to face the grim situation. Lakhs of people are affected during the period of scarcity and famines. The Government suffers heavy financial burden in two ways, firstly, relief expenditure has to be incurred by it, and secondly, land revenue has to be suspended, which reduces the revenue receipts of the Government to a substantial extent. The food production and supportive animal husbandry activities get affected in a large way. People not only loose money invested in farming and live stock but also loose on their capacity to do so next time. One can imagine what a draught for few successive years can do.

Water Management in Rajasthan

- Finite availability of water in the face of increasing demand. Issue of equity and efficiency.
- Minimization of losses
- optimization of water use. Short fall of the original expectations from the project resulting in lag between potential created and utilized. Poor revenue earnings



- projects are loss makers. Poor maintenance of the projects. Poor water quality.
- Less awareness about the water management among the people.
- Project inadequacies in regard to timely and adequate supplies of water.
- Inadequate infrastructures for quick communications for regulation and control of water.
- Non adoption of latest technology of water application in the field.
- Improper mining of ground water resulting in increase of dark zones.
- Need for the suitable Ground water legislation.
- Ground water pollution due to effluent discharge in the rivers or drains.
- Society's inability to respond to local water management.
- Competition in access of water spatially.

- Existing legal framework to manage water needs refinement.
- Lack of dialogue between the bureaucracy dealing with water management and the users.
- Fragmented development of catchment areas of water bodies.

Water Policy of Rajasthan

The requirement of utilizing all available water resources, surface and groundwater, in a judicious and equitable, as well as sound economic manner needs a well defined State Water Policy. The Government has announced water Policy. The broad objectives of this policy are as under:

- (i) Development of all utilizable water resources to the maximum possible extent.
- (ii) Assuring an integrated and multidisciplinary approach to planning, evaluation, approval

and implementation of surface and ground water projects.

(iii) Optimization of water resources

(iv) Judicious and economical sound allocation of water resources to different sectors with drinking water supply as a first priority. Maintenance of water quality at acceptable standards.

(v) Promoting beneficiaries participation in all aspects of planning and management

(vi) Motivating and encouraging water conservation through appropriate socially acceptable water rates.

(vii) Emphasis to be given for recharge of ground water aquifers to mitigate the crises of drinking water supply and industrial demand.

Priorities in water resources development and Management:

Domestic and livestock water needs must be met at the highest possible priority. The development of additional water sources for other purposes mainly agriculture & industries, the management and maintenance of such development projects existing and future should be programmed on economic viability and sustainability grounds. The water use in Rajasthan is dominated by agriculture sector. There is a need for the efficient use of water in this sector.

Coordination and control

Water Resource Department, Government of Rajasthan is engaged in activities related to planning, development, distribution and monitoring of surface water of the state. The organization has to operate in an environment that includes both internal influences and external forces. The external environment comprises the interacting forces of the water users, politicians and contractors etc. The internal environment comprises elements such as organizational culture, motivation (includes carrier opportunities, transfers, promotion etc.) and organization mission. The mission of the department is to effectively plan, harness, develop and manage, in a well-coordinated manner, the state's surface water resources.

To be responsive to the water user's needs and to meet their requirements in an efficient, effective and environmentally sustainable manner, for the present and future economic development.

Development of surface water resources in Rajasthan

The part of water potential available in state is harnessed by

existing major medium and minor irrigation projects. The total irrigation projects in the State are 5208 (2315 preplan), in which 113 (43 preplan) are major-medium & 5095 (2272 preplan) are minor projects. The state has constructed 2893 irrigation projects in different plan periods. This includes 70 major and medium projects and 2823 minor projects. The expenditure incurred in construction of the irrigation projects in plan periods up-to the X five year plan (2002-07) is Rs. 10360.59 Crore. If we calculate the net present worth of this expenditure, it will be much higher. The number of such projects constructed in different five-year plans is given in Annexure table3.

On Going Irrigation projects

State has taken up contraction of new Major, Medium and minor Irrigation projects and rehabilitation of existing irrigation projects under state plan as well as other funding agencies like World Bank, NABARD and AIBP. The following major projects are in progress

- Indira Gandhi Nahar Pariyojana (IGNP)
- Narmada Canal Project
- Mahi Project
- Ratanpura Distributory
- Bisalpur Irrigation Project
- Rajasthan Water Sector Restructuring Project

In addition to these, Construction of medium and 56 minor irrigation projects are also in progress.

Water Harvesting Structures

To raise the ground water table by better water management, State Government has prepared a master plan for the construction of water harvesting structures. The construction of these structures is being taken up in phases. The sanction for 3298 structures costing 317.42

Crores, located in 28 districts

has been given. The work on 2192 structures has been started so far. Out of these 1892 structures have been completed. Remaining 300 works are in progress. Government is trying to take help of NGO's in the construction of these water-harvesting structures.

Performance of Irrigation projects

The irrigation projects involving both physical works and human activity are not static. They are continuously evolving and changing. Major changes generally recognized are those associated with the rate of physical deterioration relative to maintenance of the project. The surface irrigation water is made available to the cultivators through canals at a very high cost by the government and the charges levied are very less. Since the procedure for distribution of water is not well defined in most of the command areas of irrigation projects, it faces one common problem of how to co-ordinate the different actions of individual user and to ensure optimal utilization of irrigation water in the whole command area, of which overall parameters and water rights are well defined. The need for management and co-ordination is necessary, as resource is just sufficient to meet the demand of the command area.

To effectively manage the irrigation water supply system, the entire conveyance/ distribution system and the discharges from the outlets provided to serve the farm units must be in such a way that system maintains adequacy, equity and timeliness in supplying the irrigation water. The operation of an irrigation system requires a fixing of schedule of water describing where to allocate and when to deliver. This decision is followed by an execution phase. Execution of schedule has to ensure

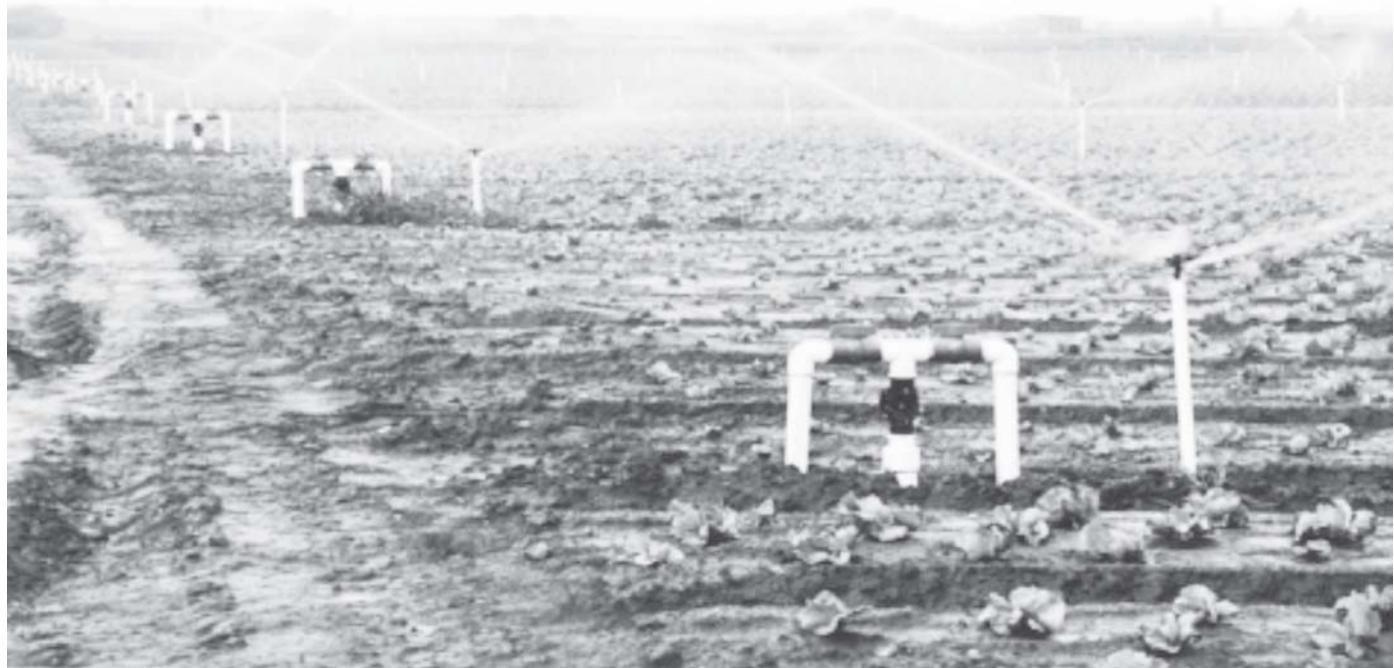
that the basic objectives are fulfilled. The overlap of water supply system with the agriculture domain is complex because the irrigation manager's attempt is to allocate water in such a way that, it is distributed equitably and fulfills the individual and collective requirements of user.

up-to outlet level is with the Water Resource Department while the management of water below the outlet through watercourses is with the cultivators.

Now the emphasis is being made on the state to act as the central actor

surface irrigation system performance, efficiency and strengthening agriculture support services in selected schemes through increased involvement of users.

To strengthen capacity for strategic planning and



This needs communication and responsiveness between the irrigation agency and farmer to a great degree. This can be developed with the Participation of beneficiaries in management.

Participation of beneficiaries in management: The irrigation water management policy is undergoing a dramatic shift with the intervention of the foreign funding agencies in India. At present the state is responsible for management of irrigation water by up-keeping the irrigation channels and running the canals with an agreed schedule in the meeting of water distribution committee, which comprises off administrators as well as technical officers of the project area. The meetings of water distribution committees seldom contribute to get the active participation of the cultivators. The operation and maintenance of irrigation channels

in development and managing the irrigation water potential up-to the main canal and branches while the management in the minor should be given to the farmers. The role of farmers in the management of irrigation system is vital for successful irrigated agriculture development, as they are the ultimate users of the irrigation infrastructure. For optimal productivity, individual farmer is required to use the water made available to him with the maximum water use efficiency. However, the system operates successfully only if each farmer behaves and cooperates in such a way that his each action in using the water assists the management process. The World Bank funded project Rajasthan Water Sector Restructuring Project (RWSRP) is conceived to improve the efficiency of water sector with the following objectives to improve

environmentally sustainable development of surface and ground waters resources in Rajasthan.

One of the key strategy gradients of the project is “Fostering greater user participation and partnership building among stakeholders in the water sector through transfer of irrigation management to WUAs”.

To work on this strategy, the State Assembly passed Participatory Irrigation Management (PIM) Act and the rules in this regard were framed. Subsequently, 509 WUAs have been formed on 91 irrigation projects to involve farmers in Irrigation Management. The rehabilitation work on these projects is in progress and it is proposed that as soon as this work is over the



Construction of medium and 56 minor irrigation projects are also in progress.

management will be transferred to the WUAs. It is presumed that the WUAs will start working. The hope is that these WUAs will bring about better water management. More correctly, the Govt. may gain through better utilization of irrigation sources, better maintenance & operation of the irrigation system, better enforcement of discipline, better communications and hopefully, better relations with the client population. Other attractive possibility is to transfer the responsibility for collection of taxes.

Sustainability of WUAs

1. Possibilities of conflicting views on account of differential socio-economic conditions.
2. Possibility of local social and political dynamics of relations. This will influence functioning of WUA.
3. Problem in fund collection due to lack of authority to punish and reward.
4. Interference of family relations and informality in the operation of WUA.
5. Conflicting interests of members may create disharmony if the leader of group does not take care
6. Possibility of violation of rules and directives due to over

confidence, local misguidance, misconceptions about power in leadership.

The broad steps for transferring of PIM to the farmers

The broad steps for sustainable success of PIM from PRA technique are as follows.

1. Rapport building and establishing communication links with the farmers;
2. Learning from such farmers about their relationship with the existing water management and recognizing the priorities, preferences, problems and assessment of their capacities;
3. Strengthening farmer's relationship with the water management through local driven action plans, their implementation and evaluation towards sustainability and also linking up the farmers with the Irrigation Department.
4. Commitment by both farmers and the departmental engineers in the process of ensuring people's participation;
5. Monitoring the process of people's participation;
6. Coordination at different levels.

Strategy for Transfer of

management to local people: The local people assess and evaluate the water resources made available to them in terms of their knowledge and experience. It is they who account for the cost, benefit, strength, weaknesses, opportunities and threats. It is they who analyze, describe, define, decide on sound conditions and act to manage water as per their requirements.

Simply framing the act and rules thereon cannot develop the strategy. Something beyond will have to be done, so that the farmers conceptualize the PIM and they adopt it in a sustainable manner. If most of the farmers in a WUA are disciplined and they are working together for the objectives of this new institution, then only the success in transferring the management will be there. Therefore, the strategy for transfer of management has to be developed keeping in mind the constraints of socio-political environment & the leadership style of irrigation engineers.

The strategy could be based on the principle of learning and listening through participation and learning and working progressively. The closed mindset of the professional, approaching the farmers will not be successful.

"Engineer" the job of irrigation manager to fit irrigation management:

Leadership style:

Every irrigation engineer is working in two different situations simultaneously. In one situation their job is to handle the construction activities and to administer the staff working under them. Which includes their promotion transfers, postings, court cases, other administrative matters etc. In other situation he has to perform the duty of irrigation

water manager. These two situations require different leadership styles. In the first situation the authoritarian, highly directive leadership style works best while in the

second situation the more permissive, human relation oriented and favoring the belief of equal rights, benefits and opportunities works best.

Some engineers are having the leadership style as given in situation one and some has as per situation two, while a few has the combination of the two. This results in failure in one situation in most of the cases.

Now we have to choose the appropriate leadership style, so that training and environment, to the irrigation manager can be given for achieving the targets of irrigation management. On the face of it, the first style of leadership is best in case of construction activity, while the second style works better for irrigation

management.

There is a need to recognize or diagnose group task situations. This is only possible when there is a segregation of the two situations i.e. water re

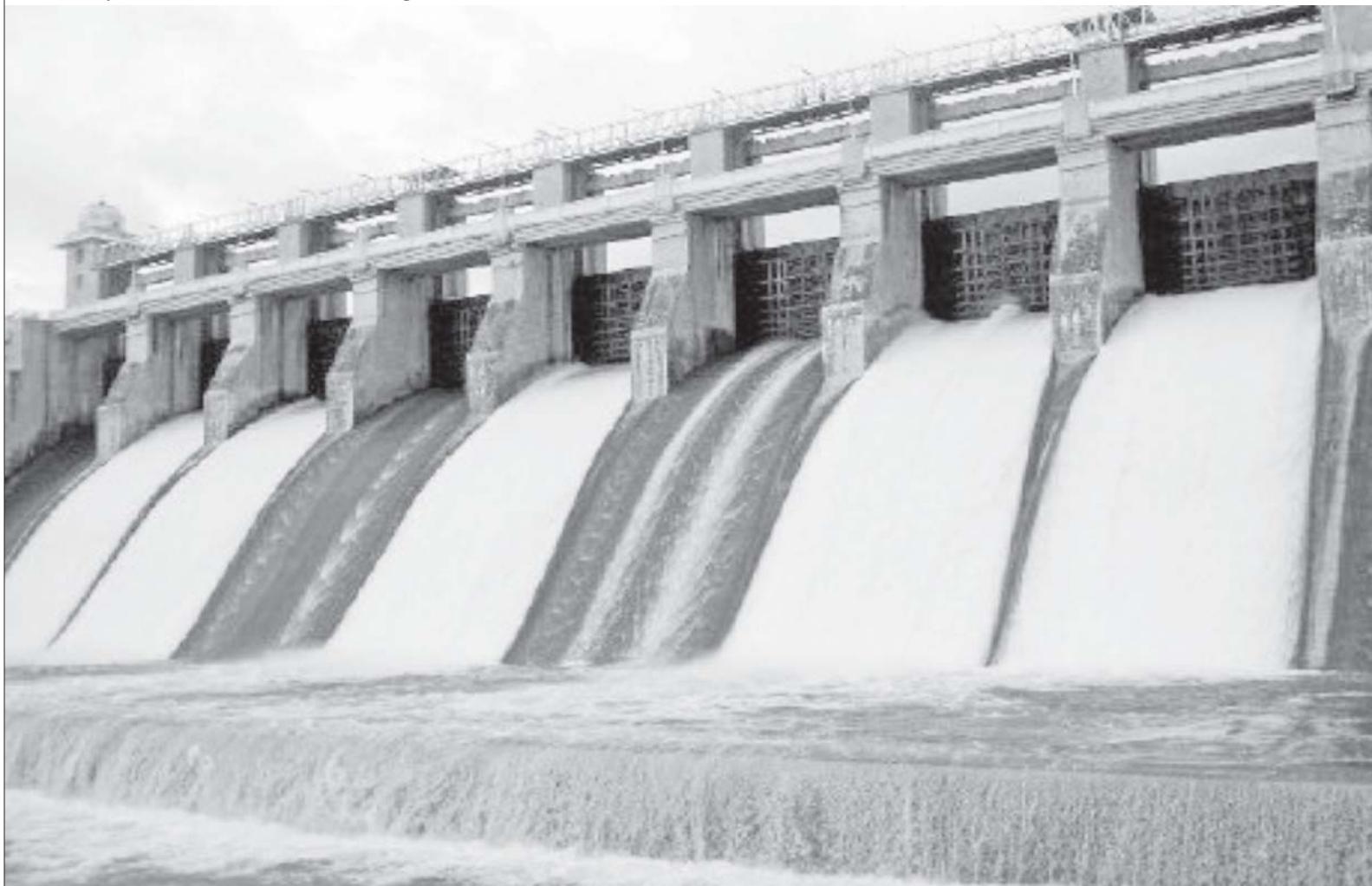
source development and the irrigation management. There is a need to separate out the construction activities, which requires the directive style of leadership. At present the Water Resource Department is creating more and more irrigation potential by constructing the dams but the optimum utilization of the water stored in the dams is not finding place, as there is not sufficient work environment for effective water management. The reason being the diversity of work situations as explained earlier. Due to this diversity, they are not able to perform the duties of a good irrigation manager.

The above analysis indicates the

need for creation of separate group of engineers mixed with the Public Service Contractors (PSC), for irrigation management, so that a separate work environment can be created which suits to perform the duties of good irrigation manager. We may try to "engineer" the job of irrigation bureaucracy to fit the irrigation management? This alternative is potentially the most feasible for irrigation management. This indicates that the new institution should be created which can work as service provider.

Transferring of the irrigation management will involve following two roles.

1. To supplement technical requirement in regard to scheduling of irrigation, warabandi, maintenance options for the projects, collection irrigation dues, maintenance of



Annexure Table 1: Basin wise surface water availability

S.No	Basin	Districts coverage	Surface water availability at dependability of	
1	Shekhawati	Ajmer (8), Alwar (5), Jaipur (18), Jhunjhunu (21), Nagaur (23)& Sikar (25)	50 % 161	75 % 91
2	Ruparail	Alwar (71) & Bharatpur (29)	2021	153
3	Banganga	Alwar (25), Bharatpur (31), Dausa (24), Jaipur (17), Sawai Madhopur (3)	516	324
4	Gambhir	S. Madhpur (62.9), Bharatpur (29.3 %), Dausa (2.9), Dholpur (4.9)	550	315
5	Parwati	Dholpur (82), S. Madhpur (17), Bharatpur (1).	182	117
6	Sabi	Alwar (62), Jaipur (27), Sikar (11).	223	126
7	Banas	Ajmer (12), Bhilwara (20), Chittorgarh (12), Dausa (2), Jaipur (14) Rajsamand (10), S. Madhopur (10), Tonk (15), Udaipur (5)	4039	2789
8	Chambal	Kota (17), Jhalawar (19.8), Baran (21.9), Bundi (17.7), Chittorgarh (9.4)	10053	6723
9	Mahi	Banswara (29), Chittorgarh (13), Dungarpur (19), Udaipur (39)	3149	2023
10	Sabarmati	(Udaipur (82.3), Dungarpur (15.6), Pali (0.5), Sirohi (1.6)	800	474
11	Luni	Pali (33.3), Jalore (23.6), Barmer (17.6), Sirohi (5.6), Ajmer (5.4), Nagaur (4.9), Jodhpur (8.1)	821	382
12	West Banas	Sirohi (0.5), rest in Gujarat	406	217
13	Sukali	Sirohi (0.3) rest in Gujarat 112	50	14
14.	Other Nallas	Jalore (92), Sirohi (8)	32	9
		Sub Total	21246	13756
15	Outside basin	Thar Desert	468	366
		Grand Total	21714	14122

(Figure in Parenthesis are percent contribution in catchment area.)

Annexure Table 2: Allocated share from inter state rivers

S. No.	River	Date of Agreement	Allocated Share	Parties to the Agreement MAF/MCM
1	Ravi Beas (Pre partition)	04-09-1920	1.11	1369 British Govt, Nawab of Bhawalpur & Maharaja of Bikaner
2	Ravi Beas (Post Partition)	31-12-1981	8.60	10604 Haryana, Punjab & Rajasthan
3	Sutlej	13-01-1959	1.41	1739 Punjab & Rajasthan
4	Chambal	-	1.60	1973 Madhya Pradesh & Rajasthan
5	Mahi	10-01-1966	0.37	456 Gujarat & Rajasthan
6	Narmada	07-12-1979	0.50	617 Gujarat, Maharashtra Madhya Pradesh & Rajasthan
7	Yamuna	12-05-1994	0.91	1119 Delhi, Himachal Pradesh, Haryana, Rajasthan & Uttar Pradesh
	Total		14.50	17877

Annexure Table 3: Plan-wise Financial and Physical Achievements in Irrigation Sector

S.No	Plan period	Number of Irrigation Projects	Cumulative Potential . Created in Million Ha	Cumulative Expenditure . Incurred in Crore Rs	Major & Medium	Minor	Total
1	I Plan (1951-56)	3	186	189	0.503	24.91	
2	II Plan (1956-61)	30	69	99	0.644	60.27	
3	III Plan (1961-66)	8	100	108	0.9921	36.28	
4	Annual Plans 2 (1966-69)		44	46	1.154	176.38	
5	IV Plan (1969-74)	3	317	320	1.317	277.50	
6	V Plan (1974-80)	6	286	292	1.771	620.89	
7	VI Plan (1980-85)	-	242	242	1.994	1094.19	
8	VII Plan (1985-90)	4	338	342	2.232	1850.319	
	Annual Plans -(1990-92)		453	453	4.651	2296.48	
10	VIII Plan (1992-97)	4	319	323	2.664	4339.54	
11	IX Plan (1997-02)	6	142	148	2.955	6596.75	
12	X Plan (2002-2007)	4	327	331	3.540	10360.59	
	Total	113	5095	5208			
	Achievement in Plan periods	70	2823	2893	3.540		10360.59

Source: Annual report, Water Resource Department, GOR. 2006-2007

different registers for the monitoring and evaluation etc. in managing the irrigation system.

2. Raising awareness and build up organization of farmers. This will be based on the sense of collective empowerment, understanding, knowledge, competence and self confidence in order to determine their own rights.

These two roles cannot be recognized separately and will have to be performed simultaneously because they are supplementary to each other. The specialist of the roles will have to be identified, as there cannot be one-man show in this regard. An irrigation engineer can perform the first role, while NGO in the form of PSC can perform the second. There is a need to create a separate organization in which the irrigation engineers and the NGO can work together. This institution can work as umbrella for the small NGOs who will be working in the field. Blueprint of the new organization: The work of transferring the management can be done with the creation of following institution.

1. Governing council
2. Steering committee
3. Lead NGO
4. Field NGOs

Governing Council

The Governing Council can provide the basic policies of the Government to design the strategy. This council can be headed by Minister of Water Resources, Government of Rajasthan and represented by the Finance Department, Planning Department, Irrigation Department,

and eminent Irrigation Engineers & Social Scientists. Principal Secretary Water Resources can be Convener of the committee. This Council may meet as and when required.

Steering Committee

This Committee can design the strategy. Principal Secretary Water Resource may chair this committee.

Chief Engineer Water Resource, Rajasthan, Head of the Lead NGO, Irrigation Engineers on deputation to Lead NGO and an eminent Social Scientist may be the members. The Convener of this committee can be Head of the Lead NGO. The work allotment to field NGOs may be decided by this committee after identification of good field NGOs. The committee can meet once in a month and take care of the progress of work on the basis of some evaluation criterion.

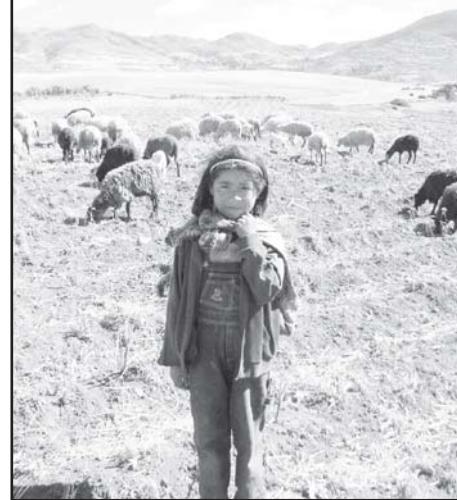
Lead NGO

An eminent NGO can perform its role as Lead NGO, with the help of irrigation engineers working on deputation to this organization. This organization will be free to select any irrigation engineer up to Superintending Engineer. The salary to the selected engineer will be given one scale higher to promote the motivation dimension and to create work environment. The Field NGOs will be working in different projects. The registration of the Field NGOs to work with the farmers will be made by this organization. The role of Lead NGO will be to provide funds, give necessary guidance to the Field NGOs and to monitor the work of transferring the PIM to the farmers through them in the different projects.

Field NGOs

The Field NGOs will be working on each project to facilitate the farmers to organize. They will be required to choose any one irrigation engineer up to Executive Engineer level from Irrigation Department to work exclusively with them. The salary to the selected engineer will be given one scale higher to promote the motivation dimension and to create work environment. The Lead NGO may decide about the number of projects given to the selected engineer depending upon the potential of work. Lead NGO will transfer the funds to the Field NGO, after receiving the recommendation of the Irrigation Engineer working with Field NGO and verification by Irrigation Engineer working with the

Looking for solution



Lead NGO.

The idea not to specify the status of Irrigation Engineer here is to provide a space for willing persons to execute this specialized work. They may also feel free to work in the manner decided by them and take their own decisions with working in the hierarchy. Their existence in the new set up will be on the basis of the quality of work.

Conclusion

The surface water availability is limited and the ground water status is also precarious in the state. Ground water is a crucial resource as more than 90 percent of the water supply schemes are dependent on ground water. Also ground water contributes to around 60 percent of the total irrigated area in the state.

Therefore the primary water management concerns, in the state are to take care of harnessing of surface water and checking the ground water overdraft. The local water harvesting initiatives can increase the supply in the near by area. Such structures can in certain circumstances have a significant impact on water availability in local areas. It is however important to evaluate the degree to which they could serve as a solution to the water scarcity at a regional level.

***Author is S. E. in Irrigation Department of Rajasthan**



WE NEED IMPROVED WATER GOVERNANCE

TO ACHIEVE THE MILLENNIUM DEVELOPMENT GOALS (MDGs)

Water governance involves dynamic political processes of power and negotiation, particularly between service providers and users. The agreed principles of good governance must be balanced with context specific initiatives. There is a particular need to work at the “messy middle” between national policymaking and local practices.

Water governance is a significant feature of international development

policymaking. There is an increasing consensus on the need for improved water governance to achieve the Millennium Development Goals. Water governance shape water policy and management and emphasizes the need for integrated water resource management, increased participation of all water users (especially women) in financing and management, and a larger role for the private sector. Water governance is embedded in power relations that often lead to the unequal distribution of other resources such as land and technology.

There is a continuing need to understand how to improve water access

There is an increasing consensus on the need for improved water governance to achieve the Millennium Development Goals. Water governance shape water policy and management and emphasizes the need for integrated water resource management, increased participation of all water users (especially women)

for poor people. Single solutions are unlikely to be effective: increasing the influence of poor people in water governance requires a range of inter-related interventions. The role of non-governmental organizations in water governance is to facilitate community-led initiatives that promote self reliance and equal access. This is important in areas where communities do not trust water regulating agencies to protect their interests, or fulfill their role as service providers and regulators.

In environmental and conservation sciences, the emphasis has been on the need for management at increasingly large scales, so that whole ecosystem processes can continue. Environmental management is typically carried out by a system of multi-tiered institutions, rather than a single institution operating at one scale. This enables each function to be carried out at the appropriate scale.

This paper is prepared to understand water governance as multi-layered, multi-dimensional and dynamic. There are no simple widely applicable arrangements of optimal governance that will always yield for outcomes. Rather, we see a rich diversity of context-specific arrangements shaped by wider processes in society. One key challenge is assessing how much these arrangements are likely to increase equity and sustainability in water access.

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Controlling Water Pollution

■ Dr. AJAY VERMA



Dr. AJAY VERMA

Life originated about 3.5 billion years ago in Water a common chemical substance that is now essential to all known

forms of life. In typical usage, water refers only to its liquid form or state, but the substance also has a solid state, ice, and a gaseous state, water vapor. Water moves continually through a cycle of evaporation or transpiration, precipitation, and runoff, usually reaching the sea. Earth's waters are filled with life. From the earliest and lowest organisms such as protozoa to the higher mammals such as dolphins and whales live in the water. Some kinds of animals, such as amphibians, spend portions of their lives in water and portions on land. Plants such as algae grow in the water and are the basis for some underwater ecosystems. Plankton is generally the foundation of the water food chain. About 70% of the fat free mass of the human body is made of water. To function properly, the body requires between one and seven liters of water per day to avoid dehydration; the precise amount depends on the level of activity, temperature, humidity, and other factors.

Human Civilization has historically flourished around rivers and major waterways; Mesopotamia, the so-called cradle of civilization, was situated between the major rivers

Tigris and Euphrates; the ancient society of the Egyptians depended entirely upon the Nile. Large metropolises like Rotterdam, London, Montreal, Paris, New York City, Shanghai, Tokyo, Chicago, and Hong Kong owe their success in part to their easy accessibility via water and the resultant expansion of trade. Islands with safe water ports, like Singapore, have flourished for the same reason. In places such as North Africa and the Middle East, where water is scarcer, access to clean drinking water was and is a major factor in human development. In India also the famous cities developed on the banks of the rivers. First of all we make arrangements for the water, whenever we develop a living unit. The parents never used to marry off their daughters to the boys of that village where there

was a scarcity of water.

Water is considered a purifier in most religions. Major faiths that incorporate ritual washing (ablution) include Hinduism, Christianity, Islam, Judaism, and Shinto. Water baptism is a central sacrament of Christianity; it is also a part of the practice of other religions, including Judaism (mikvah) and Sikhism (Amrit Sanskar). In addition, a ritual bath in pure water is performed for the dead in many religions including Hinduism, Judaism and Islam. In Islam, the five daily prayers can be done in most cases after completing washing certain parts of the body using clean water (waju). In Hinduism, water is used in almost all rituals to cleanse a person or an area. Water is mentioned in the Bible 442 times in the New International Version and 363 times in the King James



The parents never used to marry off their daughters to the boys of that village where there was a scarcity of water



Water is often believed to have spiritual powers. In Celtic mythology, Sulis is the local goddess of thermal springs; in Hinduism, the Ganges is also personified as a goddess, while Saraswati have been referred to as goddess in Vedas. Also water is one of the "panch-tatva"s (basic 5 elements, others including fire, earth, space, air).

Version: 2 Peter 3:5(b) states, "The earth was formed out of water and by water".

Some faiths use water especially prepared for religious purposes (holy water in some Christian denominations, Amrit in Sikhism and Hinduism). Many religions also consider particular sources or bodies of water to be sacred or at least auspicious; examples include Lourdes in Roman Catholicism, the Zamzam Well in Islam and the River Ganges (among many others) in Hinduism. In Neo-Paganism water is often combined with salt in the first steps of a ritual, to act as a purifier of worshippers and the altar, symbolizing both cleansing tears and the ocean. In Hinduism all the water bodies are considered holy. Water is also considered as god in Hindu mythology

(Jal Devta).

Water is often believed to have spiritual powers. In Celtic mythology, Sulis is the local goddess of thermal springs; in Hinduism, the Ganges is also personified as a goddess, while Saraswati have been referred to as goddess in Vedas. Also water is one of the "panch-tatva"s (basic 5 elements, others including fire, earth, space, air). Alternatively, gods can be patrons of particular springs, rivers, or lakes: for example in Greek and Roman mythology, Peneus was a river god, one of the three thousand Oceanids. In Islam, not only does water give life, but every life is itself made of water: "We made from water every living thing".

The Greek philosopher Empedocles held that water is one of the four classical elements along with fire, earth and air, and was regarded as the

ylem, or basic substance of the universe. Water was considered cold and moist. In the theory of the four bodily humors, water was associated with phlegm. Water was also one of the five elements in traditional Chinese philosophy, along with earth, fire, wood, and metal. Water has been a symbol of purity and it purifies as preached by every religion.

रहीमन पानी राखिये, बिन पानी सब सून।
पानी गये ना उबरे, मोती, मानस, चून ॥

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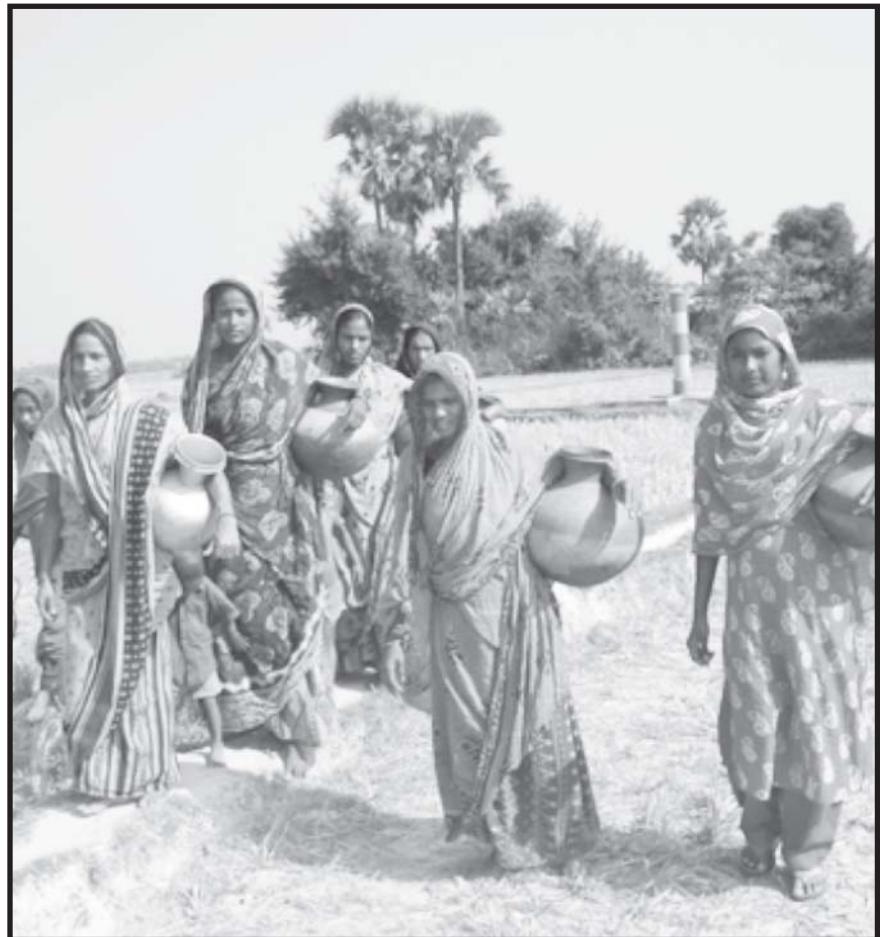
Continuing Challenges?

■ MAYANK MOHAN MISHARA



MAYANK MOHAN MISHARA

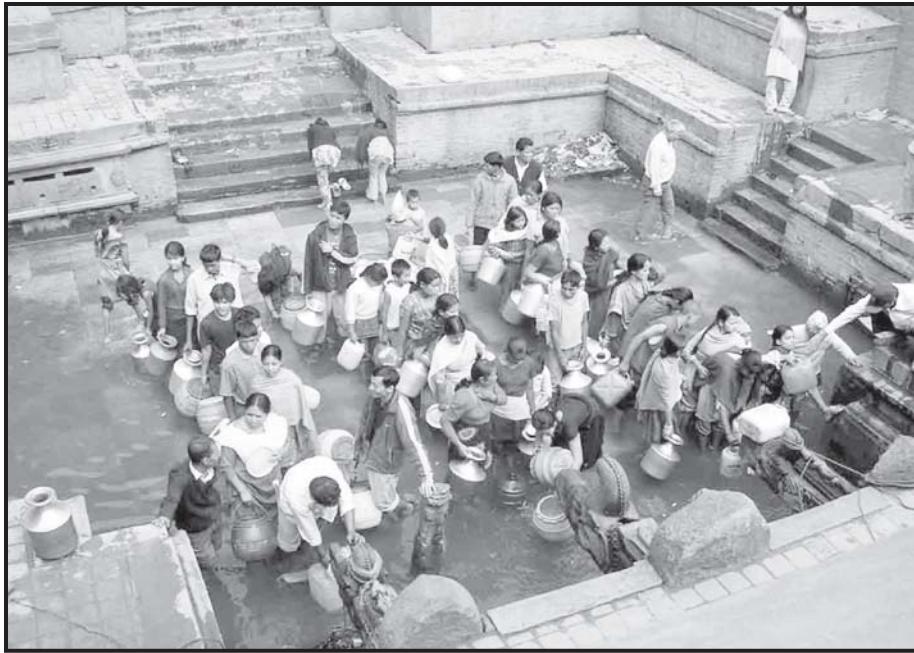
A challenging scenario presented itself to all those concerned about and involved with water in its varied dimensions at the start of the new millennium. Despite occasional good monsoons, the first five years of the new millennium witnessed the cumulative impact of years of poor rainfall in many parts of the country. Near drought conditions did little to help recharge already precarious ground water tables, as data in the earlier part of this approach paper shows. Unregulated mining of water and un-coordinated use for irrigation and industry only highlighted the deleterious effect of the absence of a rational and integrated water policy framework. Technocratic approaches of the agencies providing water did not lend themselves adequately to stakeholder inclusive methods and lacked capabilities to enhance peoples' participation. Absence of a sense of ownership and alienation from meaningful association led to a lack of involvement of the users and stakeholders water management and reluctance to participate in ensuring sustainable drinking water use practices. Coupled with a dated approach and complaints of inefficient service delivery, the water crisis presented itself as a complex multidimensional problem



calling for inputs from a variety of disciplines, perspectives and experiences.

The goal of the welfare state to ensure drinking water security, in the decades following the 1960's, saw the emergence of water praxis largely driven by the 'supply' approach. The compulsion to provide secure water at the earliest, resulted in the creation of a large technocratic set up under the aegis of the state, which planned,

executed and implemented rural water supply schemes. Central to the scheme of things was the role of professional water engineers, who subscribed to a supply driven approach, focusing primarily on the exploitation of ground water, to ensure supply of drinking water, initially by installing hand pumps and subsequently through overhead tanks and pipelines. While in the immediate present, the approach



Though totally unintended, the devaluation of traditional water management knowledge and skills played a major role in the erosion of community based traditions of water use, conservation and protection from overuse and the decline of community generated and grounded initiatives to conserve local water sources.

environment, resulting eventually in a rapidly depleting ground water table and the growing threat of water insecurity.

The centralised, supply focused water management system led to yet another unintended effect, which has only recently received critical attention. A centrally planned approach inevitably results in the undesired distancing of the community both from the problem and the urgency of sustainable solutions, displacing traditional practitioners and water management systems with the eventual likelihood of marginalizing the local community from effective water management practices. Though totally unintended, the devaluation of traditional water management knowledge and skills played a major role in the erosion of community based traditions of water use, conservation and protection from overuse and the decline of community generated and grounded initiatives to conserve local water sources. By way of a corollary, any attempt to revive or reinvigorate the drinking water sector would, therefore, necessarily have to rediscover best practices from old systems and integrate them with the knowledge gained from modern

experiences.

The nineties represented a period of critical churning and vigorous examination of the supply driven, technology oriented, government centered and implementation focused approach of the previous decades. As the Tenth Plan Approach Paper to the Planning Commission noted, "Emphasis must be laid on the participation of stake holders at all levels, from planning, design and location to implementation and management. Presently, water supply projects are designed and executed by the implementing departments and passed on to end users...this calls for radical change in the management system. Rather than being supply-driven, the decision relating to installation of water supply schemes should be based on the level of local demand and capabilities to meet the responsibility for operation and maintenance".

The pressing water crisis created the need to come up with new solutions and called for an important change in public policy, shifting the focus away from state or government driven mechanisms of water management to

systems based on increased participation of the community, local bodies and stakeholders. However, as the worsening water crisis indicates, the changed approach did not really take roots or result in the creation of alternative solutions or systems. The present initiative to create a more forward looking policy perspective gains relevance is framed by precisely these contextualities and constraints. For the sake of clarity, the otherwise seamless process is presented as four shifts.

1. From Access or Coverage to Service Delivery: Examining Issues of Efficiency Vis-à-vis Effectiveness

An interesting shift, worth examining, that occurred with the changed thrust of a people-centred water policy was the questioning of previous strategies which focused on increasing coverage or access to water and examining effectiveness in water delivery systems. This in turn, revised the standards of validating and measuring the performance of the existing water supply systems from those of 'efficient' functioning of the water supply systems to 'effective service delivery mechanisms' in ensuring adequate supply of safe drinking water at regular intervals.

This approach, in effect, was rooted in the view wherein the citizen being supplied with water was considered not merely a consumer served by the water delivery system but as a stake holder with a right to safe, adequate and regular water. By acknowledging the right of the citizen, the water department was recognizing and reflecting a shift, in self perception, from being sole determinants of all water related policies, planning and implementation to being one of several, albeit important, players in the water field.

The 'Efficiency vis-à-vis Effectiveness' approach resulted in systematic examination of approaches, practices and experiences as they prevailed within the functioning of the organisation. It has also led to an

attempt at bringing about attitudinal changes amongst different sections of the technocracy and within the state agencies as also to effect institutional transformation within the organization to align it with the changed modes of functioning.

2. Providers to Partners: Towards Water Citizenship New Frame of 'Water Governance' with the Citizen at the Center

The examination of efficiency of water delivery led to a focus shift in the assessment of the characteristics of

outcomes i.e. effectiveness with which they performed and ensured satisfactory delivery of the services, acknowledging these to be a right of the citizens. While acknowledging 'citizenship' rights, the arena of citizen responsibilities in managing a scarce resource were brought into the frame of the partnership to put in place with the communities accessing drinking water.

3. The Sustainability Enhancement Approach: Ensuring Conservation with Social Justice /Equity

the norms of equity, non-discrimination and social justice.

Accepting that the thrust water service delivery efforts would address adequate water not only in the present but also the future brought the sustainability perspective to the center of a vision of access to water, involving issues of conservation and scientific, rational and appropriate use of water. In sum, the sustainability approach would have to be rooted in a holistic, integrated and multi-dimensional perspective on changes in the water sector.



efficient system functioning, covering issues of cost-efficiency, optimal system functioning, reducing wastage and the like.

The focus of examining effectiveness of service delivery and in the present context, the provision of safe, regular and adequate water, brought to the centre of the debate, an important facet; namely, the water providers responsible for delivery of services were also accountable for the

The changed perspective of examining system performance around issues of efficiency and effectiveness is however foregrounded on a much more pressing imperative; ensuring the sustainability of water system. Such an approach, by its very nature implies that the thrust of all water service delivery efforts would ensure not just continuous supply of adequate water to all people for the present and the future but the service would also be circumscribed by

4. Partnership for Drinking Water Sustainability: Toward Enlightened Water Citizenship

The challenge confronting the drinking water sector is multi faceted and multi-dimensional today. Defining the challenge of partnership of the service provider with the user community evolving to an enlightened water citizenship of the numerous partners will remain an on going

process. The challenge of partnership will begin by addressing the following key concerns.

Dimensions of the Challenge

1. The first concern is strengthening water security by ensuring the supply of adequate amount of safe drinking water to all citizens of the state in a manner which does not further endanger the already precariously poised water system, in other words, in a manner ensuring sustainable and safe water utilization systems.

2. The second concern lies in encouraging and enabling active partnerships with a shared goal of building sustainable water systems between government departments, local bodies, actual stake holders and wider representatives of civil society.

3. The third concern is concrete efforts towards institutional transformation of both formal and traditional water management systems to ensure restructuring water access systems which would realize new norms of conservation, appropriate use of technology, knowledge and skills, and approaches based on values of equity and social justice thereby resulting in better functioning of the water institutions and effectiveness of water delivery services.

4. The fourth concern is concurrent work towards reviving traditional water bodies and management systems while sensitizing and empowering stake holders and local community to play more active and intense role in managing the water systems

5. The fifth concern is achieving convergence and coherence in policy formulation, planning and implementation to bring about 'Convergent Community Action' by bringing together state service provider community and officials with an informed, involved and active community.

6. The sixth concern is creating a sense of common ownership, identity of

interest and understanding of mutually complementary roles of the various stake holders aimed at enabling sustainability of water systems.⁷ The seventh concern is concrete work for capacity building of different stake holders including government officials, women and local communities, local bodies, NGO representatives and elected representatives

8. The eighth concern is strategically utilization of the technocratic and managerial expertise of the state agencies as the starting point to transform the organisation into a more people focused, community responsive and publicly accountable organisation.

Building Blocks of the Sustainability Approach

The thrust of the sustainability approach recognises the primacy of four factors:

Resources – Sensitivity to the fact that water as the primary resource, is finite, limited and precariously positioned today thereby calling for a comprehensive, holistic and integrated plan for conservation, utilization and management which would ensure sustainable access.

Practices – Encompassing water supply, delivery and use practices amongst the diverse consumers of water built on the presumption that changes in practices, reflecting the norms underlying the sustainability approach and rooted in values that will acknowledge the rights of citizens, ensure equity in supply and stimulate participation of all sections of the partner communities, are imperative.

People – Recognising the importance of an equal role for all people irrespective of differences amongst themselves, thereby inviting and sustaining their involvement and participation in all programmes aimed at ensuring sustainable water delivery system, based on a sense of common ownership, shared responsibility and mutual respect for all.

The task of bringing about sustainable water systems therefore requires a serious examination of current perspectives, practices and policies relating to use of water as a resource. Implicit in the changed shift in focus is the following:

Shifting from a perspective of water as a resource to be 'exploited' to a rational appraisal of water as a limited and finite resource which needs to be conserved, managed and used in a sustainable manner.

Creating Partnerships for Drinking Water Sustainability

The proposed perspective looks at changes in policy and legal framework which seeks to shift the approach from implementing new schemes to management of the drinking water sector. The shift from exploitation of water to conserving water to sustainable management of water requires the active involvement of the various stake holders, including state agencies by ensuring a unique 'Partnership in Drinking Water Sustainability'.

The Partnership is premised on the following principles:

1. Acknowledging the fact that while not all players may play similar roles and share same responsibilities all partners play an equal role and should have a say in ensuring sustainability.

2. Acknowledging that true partnership cannot be the sole responsibility of any single entity or player but that all persons and groups have a responsibility to invest in and nurture the partnership even while the stronger player, the state agencies have a greater responsibility to play a critical role to see that norms of equity, social justice and non-discrimination are followed in policy and practice.

3. Respecting that such partnership in an unequal society must remain sensitive and responsive to issues of social justice and the imperative of reaching the unreached,

i.e. the socially excluded and marginalised groups including women, children, aged, dalits and other such socially and economically deprived segments.

4. Realizing that the partnership will necessarily be responsive to the real need of water and is a measure of the community's (i) involvement (ii) interest and (iii) Investment (of any type including of labour, time and resources).

5. The partnership would aim at involving the community in

- ◆ Planning and decision making
- ◆ Investment
- ◆ Implementation
- ◆ Usage
- ◆ Managing and Regulating.

6. The partnership aims at creating shared ownership to ensure:

- ◆ Equity in access
- ◆ Equity in allocation
- ◆ Monitoring.
- ◆ Conservation of Resources
- ◆ Self Management

The five cornerstones of the Partnership in Drinking Water Sustainability' are:-

- ◆ Conservation
- ◆ Partnership
- ◆ Community ownership
- ◆ Self Management
- ◆ Democratic decision making

Mindset shifts

The need for attitudinal shifts amongst the state officials hitherto in charge of water supply schemes and covering the varied stake holders and citizens groups involved in the water sector covering consumer groups, NGOs, water user groups and civil society organisations cannot be overemphasized. The requisite, of a conscious change in addressing the other, acknowledges the difficulties inherent in power holders having to voluntarily share their powers and

authority with others, who until recently were the recipients of their munificence and subjects of their largesse. But this shift also calls for sensitivity and pro-action based on the belief that mere devolution of power without empowering people, through training and capacity building to handle the new responsibility of being co-owners in sustainably managing water resource, will end up in reducing the new perspective to mere ink on paper. Just as it is difficult and emotionally wrenching for a person in power to relinquish it, it is equally difficult for a person till recently not having been allowed responsibility to being made accountable for a new role as co owner. This is especially so when the larger populace has become habituated to hand outs given free to them without any obviously stated responsibility to maintain the services offered to them.

Shifts in Roles and Responsibilities

Learning to take charge of new systems entails all the players in the water field assuming new roles and responsibilities. Thus merely assigning powers over planning, implementation and monitoring water systems by itself will not produce expected results unless it is accompanied by capacity building of the non-technical stake holders. Equally critically, different players should be enabled to perceive the wider dimensions of the new policy framework before they can identify the role they can play and the responsibilities they would need to shoulder under the new dispensation. To make the partnership truly relevant and successful there should be as much

clarity about the roles that different stake holders have to play as their responsibility in maintaining the systems in a sustainable manner. To summarise, what is called for is a combination of the three changes typologies.

- ◆ attitudinal transformation,
- ◆ perspective change and
- ◆ institutional reorientation.

The Path Ahead: Breathing Life into Concepts

The greatest challenge before the water sector today is to initiate relevant changes towards achieving full partnership in the goal of water sustainability. The following three types of initiatives may be considered as part of the process of actualizing the new perspective of sustainability enhancement approach.

1. Governance Initiative The Change Management Programme
2. Creating Service Delivery Improvement Partnerships Towards Total Community Water Management
3. Creating Consensus through Consultations Investing in consultations as a process of evolving consensus on strategies to ensure sustainability of water programmes.

1. Governance Initiative

- ◆ Governance is a two-way process involving stat institutions and civil society
- ◆ Governance is not just about procedures and practices but also a b o u t A T T I T U D E S , S E N S I T I V I T I E S a n d SENSIBILITIES.
- ◆ Governance is not inherited but LEARNT.
- ◆ Governance encompasses the state but also TRANSCENDS the state.
- ◆ Governance involves the civil service, civil society organizations and citizens in a CRITICAL, CONTINOUS and COLABORATIVE
- ◆ Good governance is about Democracy with Development and Dignity."

The initiative would need to focus on the following types of changes:

- i) Attitudinal changes of members of the organization – Addressing the manner in which individuals perceive their own roles and functions and nature of relationship

between themselves, the Water Board and the community at large.

ii) Attitudinal changes within the organisation – Encompassing the manner in which the organisation relates to the ordinary citizen, now being addressed as a 'consumer' of the services offered by the Board, with the aim of reaching the unreached.

iii) Attitudinal Changes of key stakeholders – Focusing on a concurrent change in the way other

democratize water management.

2. Creating Consensus through Consultations

Consensus seeking through participatory democratic community process is the key to the entire change process. The effort to maximize inclusion and spread the web of democratic relations as wide as possible is central to evolving consensus on key elements of the reform process. Energy of the sector is invested through a



stakeholders and the community at large also perceive the relevance and importance of the Board and the services it offers. This is premised on the fact that where people see possibilities of meaningful and purposive interaction with the service provider they will naturally engage in a sustained relationship for mutual benefit, leading to sustainable and equitable services. What is critical to the process of governance reform is the active involvement of various stakeholders and a clear definition of the roles and responsibilities of various players. It is in this background that the task of formulating a programme which will invite and persuade different social sectors to participate in the exercise to

process of organizing consultations at different levels, from the individual village to the local, regional and state levels and amongst all the various players in the water sector. The consultations are premised on recognizing the value of the experience, skill and knowledge of all persons and groups and giving equal opportunities for all persons to share their views, opinions and perspectives. Maximizing the bonding between the participants of the consultations and utilizing their energies to widen the web of the involved in central to the process of widening circles of consensus. The present initiative is meant to move the reform process currently underway within the state agency to reach out to and include all the various stakeholders and civil society representatives.

3. Creating Service Delivery Improvement Partnerships

The initiative to create consensus and widen the frame of democratic water management requires to ground itself initially in the form of Service Delivery Improvement Partnerships. The partnerships between citizens (service providers and service seekers) undertake the task to evolve a consensus on the standards relating to efficient and effective delivery of water services to the people, as the initial effort to put in place a participatory democratic governance institution that cares for water from recharge to conservation to management of sullage and sewage. Amongst other things the Partnership would aim to:

- ◆ Benchmark the optimal levels of service and evolve consensus on proposed service standards to be adopted in the short, medium and long term.
- ◆ Create a consensus regarding enforcement and monitoring of service standards, the manner of reported and supportive management information systems.
- ◆ Identifying organisational and system arrangements to ensure standards are met.
- ◆ Investing in human resources, supervision and appraisal arrangements to ensure that partners function in accordance with the changed vision and principles of action.
- ◆ Providing grievance cells or complaints gathering systems who will undertake the task of identifying and rectifying failures to deliver the promised standards.
- ◆ Evolving financial management systems to collect data on the unit costs of key services and provide information for standard and priority setting in subsequent years.

* (Author is working with an rural development NGO)

AN EXPERIENCE FOR ALL



■ UPENDRA K. SINGH

Water a synonym to Life certainly got space next to life. We have to reverse the thoughts for providing priority to Water in human life. For mankind water remains a basic need. It influences and alters the social, cultural, political and religious heritages of different communities.

The need for plentiful supply of water is universally perceived and demanded. However, much importance is not given for sustaining the water source and the quality of water. The same has got limited level of displacement when government alone thought of ensuring the water source sustainability and Water Quality. Thus, role of people definitely got important place in whole drive for water and water source sustenance and its quality.

As water determines the quality of

Human Life – it ensures better social, economic and health on an individual. Unsafe drinking water and poor environmental sanitation cause major health problem to the community. Safe drinking water must be free from bacteriological and chemical contamination.

The bacteriological contamination in drinking water may cause diarrhea, dysentery, typhoid fever, cholera, jaundice etc. Dental, Skeletal and non-skeletal fluorosis may be caused due to presence of excess fluoride in drinking water.

Water quality monitoring and surveillance plays a major role for sustainable safe water supply. The task is tremendous. This can only be achieved when common people should be involved namely, Children, Youth, Families and Community are involved in the water conservation, harvesting,

quality monitoring and surveillance. Thus role of People's participation is greater to ensure the Water sustenance and Quality of water.

Experience with Eco-water Literacy Programme:

How School Children helped in creating knowledge on Water conservation & Fluorosis –A Case of Newai Block, Tonk

The Key purpose of the project was to create awareness and education on drinking water, rain water harvesting, fluoride prevention, water quality etc. The major actors in the project are school children.

As school children are active 'change agents'. Through, children the families and community associated under Eco-water literacy project. Also, the villages are focused



through its village level institution i.e. PSG (Panchayat support Group) which are playing a catalytic role in educating people on eco-water issue, water quality, fluoride and its prevention by proper diet and removal by deflouridation technique for better health of children and the other family members.

The major objectives are stated hereunder:

- ◆ Creating awareness on water management situation
- ◆ Creating awareness on safe consumption of safe water from safe source to intake in the body safely (prevention from getting polluted in the handling and carrying water from source to consumption)
- ◆ Creating literacy on safe drinking water and its requirement for better health
- ◆ Literacy on relationship with safe water and sanitation & hygiene education
- ◆ Influencing public opinion on water issue and eco-water literacy
- ◆ Creating awareness and educating school children, teachers and community on fluorosis caused due to intake of drinking water having excessive fluoride.

- ◆ Dissemination of information on Rain Water Harvesting and technology
- ◆ Measures to prevent from fluorosis
- ◆ Ensuring water rights and entitlements of local communities
- ◆ Involving children as stakeholder of next generation
- ◆ Bring behavioral change amongst people by transferring knowledge through sustained innovative campaigns
- ◆ Solid attitude formation on eco-water literacy through participative and innovative methods

The target group

- ◆ School Children both Boys and Girls
- ◆ Families of children
- ◆ School Teachers
- ◆ Change agents

Physical & Outreach

The project activities at the field level taken up in the month December 2006 after getting approval of the base line tools from the Department of Science Technology, GOI & GOR.

The Key interventions are :

1. Baseline survey & Participatory assessment: The base line survey in participatory fashion

were conducted of schools children, School teachers and Village households/community to know that exact requirement in order to provide input for the programme in order to seek People's participation in the Water Literacy programme and what ways should be adopted to change the local practices related to rain water conservation, rain water harvesting, habits to save water, and how to ensure potable water.

At School level pre-test will be taken up to assess the knowledge and awareness level of school children on water literacy and fluoride issues. Similarly, participatory assessment of the knowledge and awareness of the community on the water issues and fluoride issue will be gathered through PLA/PRA technique. The pre & post assessment will help to measure the impact of the Eco-water literacy programme in the project area.

2. Formation of eco-water literacy clubs & Trainings of members:

As envisaged under the project 'Eco-water literacy clubs' have been formed in each of the 06 schools. It has been formed after educating children about the project and the need of the Eco-water literacy clubs in the school/village. It took almost 3-4 visits to each school prior to form the clubs of school children.

In each of the 6 schools an Eco-water Literacy clubs were formed comprising of 15-20 school children. It will comprise of both boys and girls. A two days training were organized of Eco-water literacy club members. These members of the eco-water literacy club are helping in disseminating the knowledge and education amongst peers, families and community in regular manner.

3. Training of school Teachers:

Trainings of School teachers were organized to develop capacity on various technique and technicality of water conservation, handling water and ensuring water quality. The local PHED and DST officials were involved in the process of trainings.

4. Meetings at Village level/Panchayat support Group level: From December 2006, onwards including schools, meetings have been organized every month on educating community and PSG members (a village level institution formed in every village under integrated village planning process). Women and other PRIs members are also involved in the whole exercise.

Meetings at Village level

The major issues of the meetings:

- ◆ Bacteriological contamination in drinking water source and storage at HHs level.
- ◆ Relatively high Fluoride level in the drinking water in the villages namely the Hand pumps and community well.
- ◆ How to get freedom from bacteriological contamination.
- ◆ Role of community/PSG/VYV in water quality monitoring & surveillance.



- ◆ The health hazards due to intake of contaminated water.
- ◆ How to prevent drinking water source from bacteriological contamination.
- ◆ Where support is available for getting bleaching powder and AA filter for getting fluoride free water.
- ◆ The Community had also talked about their views regarding the received tank of Nalgonda technique free of cost about 4-5 years back. They reported in the meeting the technique was not easy and getting chemicals for mixing into water to defluoridate water was not readily available. They were not very skilled in use of chemicals in required quantity. They have been told about the functioning and maintenance of AA filter and 4 HHs were order for AA filter.

5. Demonstration of Fluoride testing Exhibition & demonstrations:

The exhibitions & demonstration were organized atleast once in a month in every village at school level and community level in collaboration with Local Education department DPEP/Sarva Shiksha Abhiyan,

Schools and Community level institutions. The major components were demonstration and exhibition stall was exhibited.

In the 4-5 hours exhibitions, in additions to it demonstrations were done on rain water harvesting technique, disposal of waste water, water quality testing etc.

Also, various competitions were organized for school children, non going children, women etc. on the central theme of water conservation and water quality. The winner of the competitions were given award in the form of items of utility (long handle laddle, note books, wall clock, pen), shields etc. In the distribution of awards to the awardees the local PRIs (Sarpanch, Ward Panch) School Headmaster, Old Women of the village were involved. At Block level BDO and SDO, BEEO, BRCF were also involved.

The major attraction of the exhibition was demonstration of Fluorosis, rain water harvesting, importance of rain water conservation, water quality, safe and unsafe drinking water, demonstration of Activated Alumina technique for removal of excessive fluoride in the drinking water, food habits for neutralizing the effect of Fluorosis and sanitary practices etc.

Communication maintains and animates one's life. It is also the motor

and expression of social activity and civilization. The task of communication become even more complicated and subtle – to contribute to the liberation of mankind from want, oppression and fear and unite it in community and communion, solidarity and understanding.

Key Initiatives:

- ◆ The VYV tied up for chlorination of wells and got the well chlorinated (getting bleaching powder from local PHC).
- ◆ The water source near school was cleaned by school children and school level committee members.
- ◆ The defunct bore wells/ wells were used in rain water diversion for recharging of ground water.
- ◆ The school filters of AA were put in regular uses which were earlier kept in store. The community/PSG and local VYV taken up responsibility of water quality testing and chlorination.
- ◆ HHs demanded for AA filter.
- ◆ Community contributing for Hand pump repair.
- ◆ PSG contacted PHED for Hand pump repair and helping in repair.
- ◆ Families are storing water safely after cleaning the pots/container.

- ◆ Use of Long Handle ladle at HH level.

Impact Visible & Learning's

- ◆ Increasing Knowledge and Awareness amongst school children and school teachers about Fluorosis, water quality and water conservation.
- ◆ Children are best change agents.
- ◆ Increasing in eco-water literacy amongst community.
- ◆ Increasing sensitiveness of water quality and Fluorosis.
- ◆ Facilitated addressing the water issue by local administrator, local MLA & PRIs and CDECS efforts has been appreciated to work on water quality and awareness/literacy in schools and community.
- ◆ School children united on the issue of water and acting as catalyst and change agent amongst peers, family and community.
- ◆ Proper use of Activated Alumina filters for removal of excessive fluoride from drinking water in Schools.
- ◆ Households Families now enquire about the Domestic deflouridation filters, its costs, availability and use technique.
- ◆ It has been understood that mere sending messages from one end to another (beneficiaries) in a linear or circular fashion does not necessarily lead to communication. There should be sharing of ideas, meaning, thoughts and feelings. This must lead to action.
- ◆ The demonstration techniques are the best to mobilize peoples and seek People's participation.
- ◆ Involving children helps in wider dissemination of information related to water in the families and community.
- ◆ The system of meeting the local water needs and then taking people for larger whole.
- ◆ Need to focus on demand responsive approach rather than supply based.
- ◆ Local institutions are key to Peoples participation in ensuring water conservation and sensitization on water quality.
- ◆ Good technical components are the preconditions of success.
- ◆ Building human capabilities is pivotal to success of the water conservation and people's participation.

*(Author is working with an rural development NGO)

यानी

बूँद-बूँद से बनता सागर,
होती जाती खाली गागर,
कुप्रबंध को करती उजागर,
तरसते बीवी, बच्चे और शौहर।

खर्च पानी करें बचा-बचाकर,
मालिक-महरी या फिर नौकर,
देखें कप्ट गरीबों के घर जाकर,
बिन पानी जीते कैसे तरस-तरसकर।

रहता खुला नल अमीरों के घर,
बेहिसाब चलता रहता दिनभर,
प्यासी जनता जीती रो-रोकर,
सोती सरकार बेखबर होकर।

देखें तमाशा सुबह-शाम नल पर,
लड़ती-झगड़ती महिलाओं के तेवर,
छीना-झपटी, बाल्टी पकड़-पकड़कर,
लड़ते जैसे सैनिक सीमा पर।

यद्यपि पानी है, अमृत भी जानकर,
नेता सोते वादे, पर वादे कर,
जीते सुख से, नयन चुरा-चुराकर,
ठगाती जनता सदा वोट दे-देकर।

सी.पी. टिंडल
उप महाप्रबंधक एवं
मंडल विकास अधिकारी
रथानीय प्रधान कार्यालय, भोपाल

COMMUNITY PARTICIPATION

■ O.P.GOYAL



O. P. GOYAL

Government of Rajasthan is executing an Integrated Water Supply, Sanitation, Health Education and Community Participation project estimated to cost US \$100

million in its first phase to provide sustained water supply, Sanitation and Health Education to about 400 villages with the assistance of Govt. of India and Govt. of Germany (through KFW). The main objectives of the project are to provide sustained/ regular water supply, improving Environmental Sanitation and Health scenario, Creating awareness to value water and stop its wastage, Payment towards water and finally Creating sense of Ownership amongst masses. To achieve the objectives of the project, help of the community has been organised right from the stage of planning to execution and then during Operation & Maintenance.

The community participation and sanitation are organised through an autonomous organisation CPU. The village distribution system is laid in the trenches excavated by the villagers through voluntary labour. Site identification for Stand Posts and Cattle Water Troughs is decided by the villagers. Maintenance and repair of the distribution system within the village is the responsibility of Water Health Committee (WHC) of the village which also decides a model for collecting water charges from villagers.

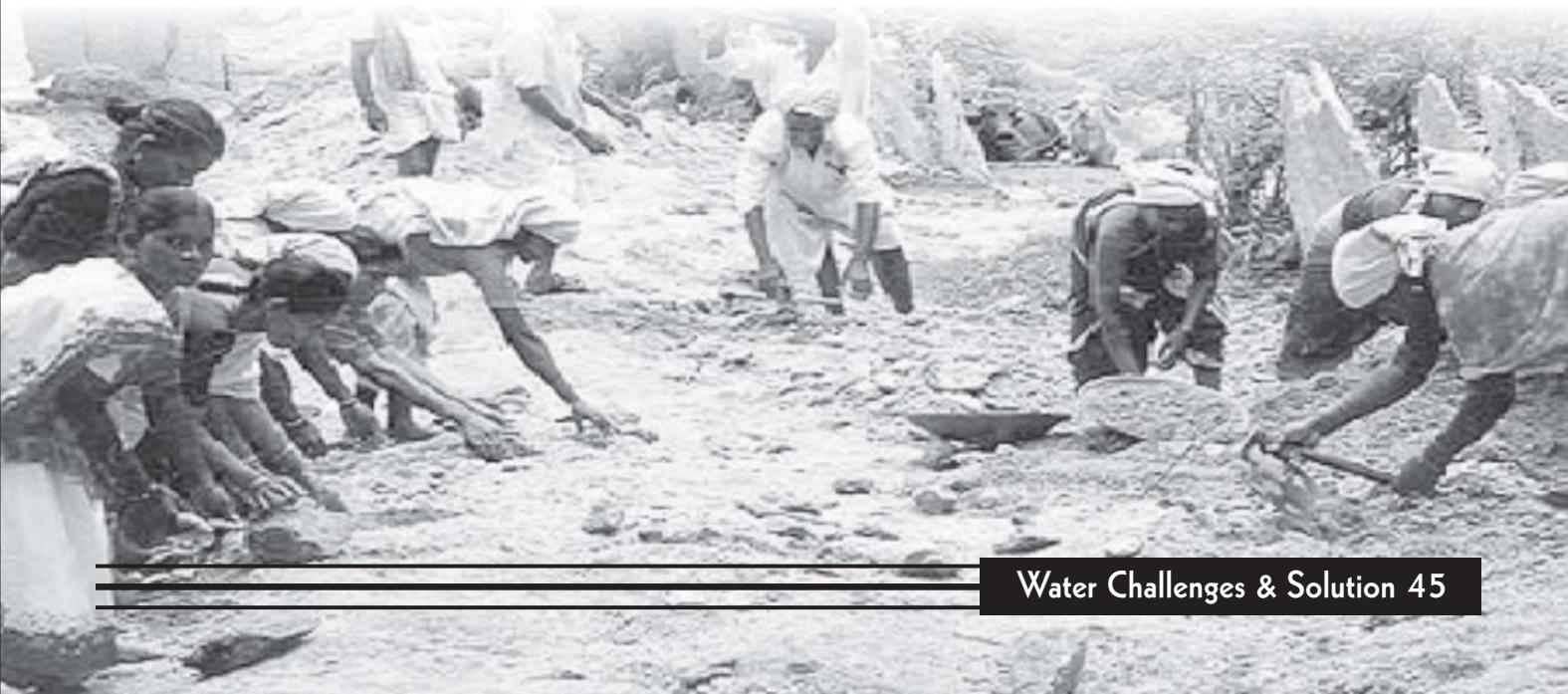
The WHC and Women Group have greatly helped in significant improvement in the sanitation level within the village, greatly enhanced consciousness for water conservation and check water wastage. One of the significant outcome of involvement of the community and cost recovery is enormous saving of water. The long queues of women and children at the stand post have almost disappeared.

So far 335 villages are getting 24 hours regular water supply at designed pressure on sustained basis; people are managing water supply within the village and are paying water charges on regular basis. Sanitation and Health status in the villages

covered have greatly improved.

BACKGROUND

Rajasthan state is located in northwest part of India and has the largest area. It has an area of 5.4 lac sq. KM, with 1991 census population as 56.4 million. The state comprises nearly 10% of country's area and 5% of its population, but it has only 1% of the total water available. The state is characterised by extremes of climatic and geographical conditions; the southeast region receives fair to good monsoon whereas the northwest region suffers from scanty and erratic rainfall. About 1.88 lac sq. Km area of the state is part of vast Perso-Arabian (Great Indian Thar) Desert, which inhabits about one third of the state's population. As availability of surface water is very much limited, drinking water requirement is mostly met from ground water sources. The quality of ground water is a major cause of concern. Ground water quality in more than 50% villages is not fit for human consumption (Unpotable). There is serious problem of excess fluorides in almost 60% villages, excess salinity in





40% villages and excess Nitrate problem in 50% villages. Thus one can term the state as **Museum** of drinking water problems. consortium, consultants in 1991 to look into the problem and suggest probable solution. It undertook study in Churu district and adjoining Jhunjhunu and Hanuman districts. The project area covered about 20000 Sq.Km having 956 villages and 11 towns. The project area has an arid climate of semi arid type with temperatures ranging from (-)2 in winters to 48°C during summers with limited areas of rain fed agriculture. Notwithstanding these adverse conditions, animal husbandry is an integral part of the economy. Infrastructure is not very much developed nor is industry. The same applies to the educational and medical facilities of this rural area. The backwardness of the area is also reflected in low literacy rate, not exceeding 10% among rural women as per feasibility report. Social structures are dominated by traditional behaviour patterns. The income of the rural population is low.

PRE-PROJECT SITUATION

During pre-independence period, people were mostly dependent on rain water as ground water was highly saline and not potable. Rain water harvesting was most commonly

practiced in both Urban and Rural areas. It was individual based in urban areas but Community based in Rural areas. Rain water used to be collected in underground covered tanks with protected catchment around the tank. The tank opening used to be locked and water use was almost rationed. However, due to very frequent failure of rainfall, people were required to either migrate or transport water from long distances during scarcity periods. In any case, it was the poor people who were to suffer potable. Rain water harvesting was most commonly practiced in both Urban and Rural areas. It was individual based in urban areas but Community based in Rural areas. Rain water used to be collected in underground covered tanks with protected catchment around the tank. The tank opening used to be locked and water use was almost rationed. However, due to very frequent failure of rainfall, people were required to either migrate or transport water from long distances during scarcity periods. In any case, it was the poor people who were to suffer from water scarcity. It was a common experience that people feared that guests would ask for water to drink. They were more willing to offer milk and butter rather than Water to the guests.

After independence in 1947, the state and central governments

looked into this gigantic problem. Water supply schemes were provided for large number of villages by tapping ground water sources wherever available, ranging from 5km to 50 kms. These schemes were mostly for a group of villages as water sources were limited. However, the quality of water of these sources was not as per standards in general, but far better than the locally available ground water. Secondly, the water sources tapped for the schemes were not sustainable on long term basis.

Meanwhile, Government Of Rajasthan (GOR) was executing a major canal project to bring water of Himalayas to the desert area.. GOR, therefore, sanctioned a water supply project from canal water with rate of water supply as 70 LPCD for about 300 villages of Churu district in early eighties. The project implementation was a serious problem on account of lack of infrastructure and hostile environment. The availability of Electric Power was most erratic and Roads were almost non-existent.

Notwithstanding government making huge investments on water supply infrastructure in Churu district, people were not relieved of drinking water problem. The quality of water supplied was not satisfactory, the supply was erratic and not dependable. The people of the tail end villages of Regional(group of villages) schemes used to starve for water.

The limitations of these schemes/projects may be summarised as below:

- ◆ Inadequate time for overall planning.
- ◆ Political interference in Technical planning.
- ◆ Lack of supervision.
- ◆ Absence of cost recovery concept resulting in waste of water.
- ◆ Indifferent public attitude to water supply system. This results in poor upkeep of the system and frequent damages/ breakdowns.
- ◆ Grossly inadequate logistics support to executing agencies.

Estimated cost(present)	Phase-I	Rs. 400 crores	Total	Rs. 1200 crores
Area Covered km ²	Phase-I	7500 km ²	Total	20,000
Population served	Phase-I	900,000	Total	2,600,000
Number of villages	Phase-I	378	Total	1,000
Number of towns	Phase-I	2	Total	11
Rural per capita supply	Phase I	35 Litres	PhaseII	40 Litres
Provision for Cattle	Phase I	30 LPU	PhaseII	30 Lt/unit
Urban per capita supply	Phase I	70 Litres	PhaseII	90 Litres

- ◆ Erratic and inadequate power supply.
- ◆ Lack of O & M culture.

THE PROJECT BACKGROUND

The broad objectives of the project are as below:

- ◆ Providing regular drinking water
- ◆ Improving Environmental Sanitation and health scenario
- ◆ Empowerment of Community and specially Women
- ◆ Creating Awareness to value water, stop its wastage
- ◆ Payment towards water
- ◆ Creating sense of Ownership amongst masses

The global project recommended by the consultants was estimated to cost Rs.847.6 Crores(\$200m appox.) at 1992 prices and envisaged water supply to 11 towns and 956 villages. Looking to financial constraints, GOR sanctioned Phase I of the Integrated Rural Water Supply, Sanitation and Health Education Program at an estimated cost of Rs.253 Crores (\$60m appox.) in 1994. The main features of the project are as follows:

- ◆ Dedicated 33 KV electrical grid with over 300 km of transmission lines and 15 switchyards
- ◆ 3 Raw Water Reservoirs with a total capacity of nearly 3 million m³
- ◆ 2 Water Treatment Plants with

- total capacity of 6750 m³/hr.
- ◆ Rehabilitation of 2 Water Treatment Plants with total capacity of 1800m³/hr
- ◆ 2 Raw water pumping stations with total capacity of about 4000m³/hr
- ◆ 4 Clear water pumping stations with total capacity of about 8,000m³/hr
- ◆ 13 cluster pumping stations of varying capacities
- ◆ 43 RCC Elevated Service Reservoirs(ESR) with storage capacities from 250m³ to 1250m³
- ◆ 93km of 1100mm and 35km of 900mm PSCC transmission pipe lines
- ◆ 400 km of 150mm-350mm DI rising main
- ◆ 1600 km of 90mm to 315mm PVC distribution pipe lines
- ◆ rehabilitation of existing AC pipelines up to 600mm dia.
- ◆ village distribution systems with Public Stand Posts(PSP) and Cattle Water Troughs(CWT)
- ◆ Urban Sanitation measures with storm water retention reservoirs and pumping stations
- ◆ supporting elements like Voice and Data Communication systems,headquarter at Churu with Master Control Centre and Regional Workshops

Key Community Participation Features

Water Health Committee (WHC) has broadly following functions:

- ◆ Village level Water Distribution Management
- ◆ Site selection of PSPs & CWTs
- ◆ Arrange voluntary labor for trench excavation inside the village to build ownership of the scheme
- ◆ Responsible for O&M of all assets within the village
- ◆ Responsible for collecting and depositing with GOR security money equal to one month's water charges and regular monthly charges
- ◆ To sign agreement with GOR for taking water at the tariff fixed by the government, O&M of assets within the village & for depositing monthly water charges with the government
- ◆ WHCs decide their own tariff structure for collecting revenue from the villagers and get it approved from the community

The project has been named as "APANI YOJNA" meaning "our scheme"

Strategy

The main weaknesses in the present system were identified as follows:

1. Waste of water due to free supply.
2. Indifferent public attitude to water

supply system. This results in poor upkeep of system and frequent damages.

It is therefore essential that communities in the rural areas be involved in the water distribution management (WDM). The participation of community should start from the stage of planning, to execution and also in operation and maintenance. At the same time, water supply should not be made free as it results in serious waste of water. This becomes more relevant in desert areas where the population is scattered and availability of water is scarce.

It was, therefore, decided to make Community Participation an integral part of the project. To make community participation effective, following activities were identified:

- I Water Distribution and Management
- II. Sanitation
- III. Health Education
- IV. Monitoring and Evaluation
- V. Community empowerment

In order to achieve the objective of Community Participation services were obtained from a consortium of 5 NGOs. These NGOs provide man power to an autonomous organisation called Community Participation Unit (CPU) located at Churu.

CPU comprises of 1 Program Director, 5 Program Officers, 6 Field Supervisors and 40 Field facilitators. The field supervisors and field teams have been divided in 6 groups each having 1 field supervisor and 6 field facilitators of which minimum two are women. In addition to these, a communication team propagates the messages about Sanitation, Health Education, Women participation and Water Management through interesting plays, puppet shows etc. Activities take place in a planned manner in the following 3 stages:

- a) Preparing action plan
- b) Executing Action plan and
- c) Follow up action after completion

Process of Community Participation:

- a) Before starting work in the village, basic data is collected from all relevant government departments at village and Tehsil level. Then formal and informal leaders of village are identified and their cooperation obtained for furthering community participation and information of the village level are collected through them. All required information is collected so that future methodology for the particular village could be prepared.
- b) Thereafter communication link is established and discussions are held through small group meetings of Men and Women in their Mohallas separately. In these meetings detailed information about the project is given and the process of identifying the likely members of the Water Health Community is started. Help is also taken from formal and informal leaders and other influential people of the village in communicating information about the project and community participation to the people. The field teams also try to understand the village culture and economic status so that they work with the community in a more effective manner.
- c) This is the most effective stage when a formal line of communication is established and the project messages are communicated through banners, posters etc. which may attract the attention of people. Efforts are made through different means to make the messages reach people. For this, mainly community group discussions, different games, exercises, rallies, health camps, puppet shows, quiz, school competition etc. are organised. In addition to this, help of models, books, posters and story pictures is also taken to communicate messages so that group discussions
- d) After an environment is built up in the village for acceptance of the project, formal meetings are held in different groups to remove grievances about the project amongst the villagers. Meetings of Village General Body (Gram Sabha) is called in which preliminary selection of the members of the Water Health Committee (WHC) is made. This process ensures selection of right members for water health committee in which 2 to 3 are women members.

Concurrently Women Group(WG) is constituted with the help of women members of the Water Health Committee. Women of all age, economic groups / social groups participate in WG, which is an open forum. Through WG, the process of their participation in the affairs of the village starts.

Water Health Committee:

The WHC is responsible for water distribution, management and Sanitation. Members of WHC are elected by village "Gram Sabha". The committee is a non-political body with Following stages of activities:

- ◆ To prepare village map and finalise location of Stand Posts and Cattle Water Troughs (CWT).
- ◆ Prepare a model for collecting water charges.
- ◆ Collect and deposit Security money and sign agreement with GOR.
- ◆ To organise voluntary labour to dig trench to lay distribution pipelines in the village.
- ◆ To organise water distribution in the village.
- ◆ To select Stand Post Attendants for

up-keep of the stand posts.

- ◆ To check and ensure no waste of water.
- ◆ To keep surroundings of the Stand Posts and CWTs clean.
- ◆ To collect water charges from the villagers through the model decided by it and approved by the community.
- ◆ To deposit water charges expeditiously with GOR every month.
- ◆ To promote sanitation program in the village.

Achievements in Water distribution Management(December 2005)

WHCs formed	360
WHCs signed agreement with GOR	360
Social map making	360
Security deposited with GOR	360 Villages
Water supply functional	344 villages
Population benefited as per 1991 census	396213
Stand Post Attendant trained	352

Contribution of Women Group:

The Women group take-up the responsibility to keep surrounding around Stand Post(SP) clean. They decide a model such as giving responsibility of cleaning around SP to each family for a day turn by turn. They also ensure that no water is wasted from the Stand Post. In many cases they also help in collecting monthly water charges. The women play a very important role in communicating the health message particularly to children. In the Self-Help Groups(SHG), small savings are encouraged. Women are encouraged to use their savings for developing sanitary facilities in their houses. Health camps play a very important role in establishing a link with village women folk.

Sanitation:

The Sanitation component aims at awareness generation about sanitation. Major activities are school sanitation program, village sanitation and construction of household

Achievements in Women's Participation

No. of Women's groups formed	318
No. of Water Group members	4218
No. of User Groups formed	2068
No. of Self Help Groups formed	222
No. of SHGs that received Revolving fund	120
No. of SHGs that received Income Generation fund	71

Achievements

No. of schools in project villages	546
No. of students given health education	35190
No. of school sanitation packages constructed	95
No. of Masons trained and in agreement	1012
No. of household units constructed	22334

sanitation units as well as toilets in schools.

Experience:

The project implementation work is in advanced stage of construction. The major components like Trunk pipelines, Raw Water reservoirs, Water Treatment Plants, ESRs, main pumping and distribution pipelines, raw and clear water Pumping Stations, Cluster pumping stations, voice communication system etc. have been completed.



The work of village distribution system including construction of SPs and CWTs has been completed in 344 villages up to Dec. '05 and water supply started. Water supply to these 344 villages is being made through the newly constructed ESRs all the 24 hrs on a regular basis with adequate pressure as per design. The internal village distribution system was laid in the trenches excavated by the villagers through voluntary labour. Identification of the sites for the SPs and CWTs was decided by the villagers with the help of CPU and the WHC of the village.

GOR has installed a Water Meter out side the village in a chamber where two sluice valves have been installed. One sluice valve is under the control of WHC to regulate water supply in the village and the other sluice valve is under the control of GOR which can be used for repair / replacement of water meter and stoppage of water supply to the village in case of default in payment. Maintenance and repair of the distribution system within the village is the responsibility of Water Health Committee. Responsibility of collecting water charges is either under-taken by the WG or by a member of the WHC. GOR undertakes reading of the water meter once in a month and deliver water bills to the WHC. The bill is to be paid in 15 days time for which a rebate of 20% of water charges is given. Any savings from the water charges collected by the WHC and that paid to GOR is allowed to be retained by the WHC. This helps in creating a fund with WHC, which can be used for repair of the distribution system, extension of distribution pipelines, and any other developmental work within the village. One of the key features of the agreement between GOR and WHC is the provision of giving rebate on water charges if GOR fails to provide water for a period exceeding 48 hours.

The WHC have greatly helped in significant improvement in the

sanitation level within the village, greatly enhanced consciousness for water conservation and also check water wastage near stand post. Surrounding around the stand post and CWT have been observed to be very neat and clean. Water charges are being deposited with GOR on a regular basis by all WHCs.

One of the **significant outcome** of involvement of the community and cost recovery is **enormous saving of water**. It has been found that the water consumption in the villages on per capita basis has significantly reduced after the introduction of the project water supply for 24 hrs a day with cost recovery. The long queues of women and children at the stand post have almost disappeared.

Issues requiring attention:

- ◆ The feasibility study envisaged an acceptable O&M system to be in place.
- ◆ The tariff needs to be revised.
- ◆ Institutional structure needs to be strengthened to give it more autonomy
- ◆ Larger involvement of people in decision making.
- ◆ Lack of O & M strategy: a consultant has suggested the operation and maintenance system after carrying out a study and detailed discussion with all concerned. However, no decision has yet been taken by the government on the recommendations made. In its absence, only breakdown maintenance is undertaken, and that too is not proper. The assets created are thus deteriorating and may result into irreparable stage.
- ◆ Presently, a special cell called Project Management Cell (PMC), taken out from P.H.E.D. of GOR, is executing the project. However, the O&M is looked after by the regular infrastructure

of PHED, which is also responsible for other works also. The staffs responsible for miscellaneous works do not have background of project philosophy and have other overriding priorities. This results in no preventive maintenance and improper breakdown maintenance. This also results in irregular supply of water in project villages at times. Institutional study was carried out by a consultant and its recommendations are pending with the government. This requires immediate attention.

- ◆ The project philosophy requires community participation and cost recovery as integral parts. It is essential that similar approach be adopted in villages around being connected to the same system. In absence of cost recovery from such villages, it may be difficult to continue present state of cost recovery and community involving in O&M.
- ◆ The project envisaged cost recovery @30% of O&M cost in first year of O&M, to be gradually increased to 100% over a period of 5 years. The project authorities submitted revision in tariff about 4 years back, but are still pending with the government. Unless tariff is revised regularly to appropriate levels, the project may become unsustainable.
- ◆ There has been frequent change of engineers on the project denying the benefit of continuity of committed staff on the project. This results in delay in implementation of project components and weakening of quality of works.

***Author is Retired Chief Engineer, PHED of Rajasthan)**

Relevant approach

SOLUTION TO WATER SCARCITY

■ **MRIDULA CHATURVEDI, WITH ARTI SHARMA, RICHA BHATT**

Natural resources are fundamentally characterized by their limited availability. With burgeoning population globally and more-so in India, the demand-supply gaps are a chronic problem that every one faces. Managing these imbalances has therefore, become and will always remain a critical area of concern for all. Net additions to the availability of infrastructure has positive macro impacts and go a long way in contributing to rapid GDP growth alongwith equitable distribution of opportunities and increase in societal welfare. It also enables the achievement of sustainable growth and development of the country resulting in robust macro-economic parameters as measured by the Human Development Index and the achievement of Millennium Development Goals.

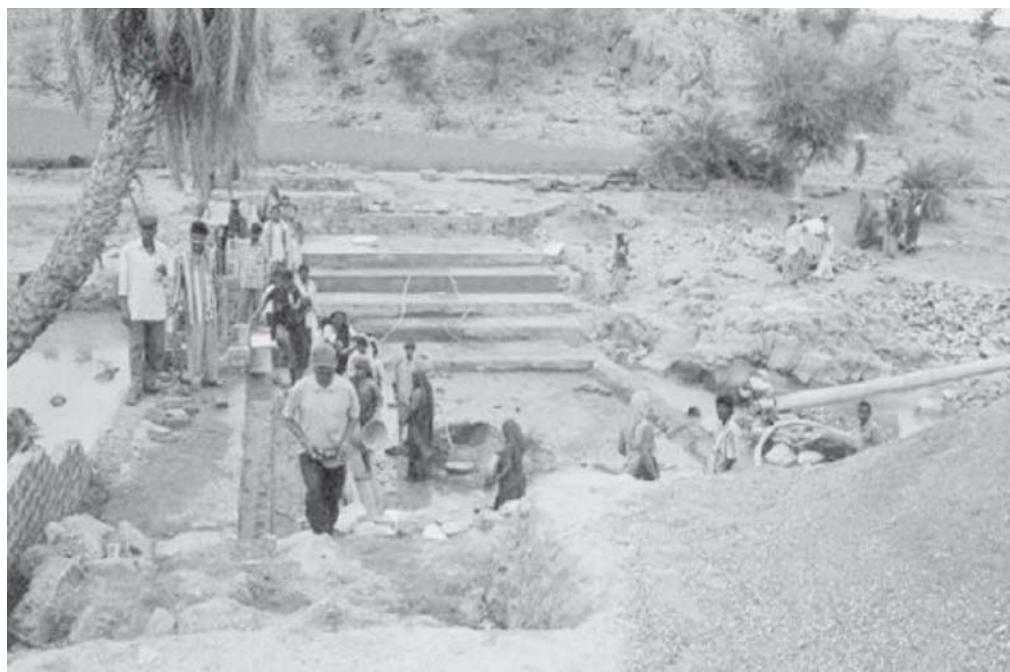
Problem revisited

Prima-facie, the problems of water could be analysed from the perspective of demand –supply mismatches. Growing population across the country and rapid urbanization have contributed to exacerbate these mismatches. These alongwith the existence of poverty and regional imbalances in growth in

development complicate the issue and therefore, any related policy responses and their impact.

In India, water availability and its regional dispersion is quite skewed and with a rapidly increasing demand component, the per capita availability falls at a rapid pace - 5,000 cubic meters per year in 1947 to less than 2,000 cubic meters per year in 1997 (World Bank 1999)). This is expected to further worsen over time to come. By 2025, this figure will fall further to 1,500 cubic meters per year. With estimates for population growth indicating a doubling in the next twenty to forty years, overall water demand in India will increase from 552 BCM to 1050 BCM by 2025, which will require the

use of all the available water resources in the country (World Bank 1999). Food production in India and the world has to be almost double in the next 25 to 30 years, and our water resources will not be adequate. In addition, it is observed that six of India's twenty major river basins fall below the water scarcity threshold of 1,000 cubic meters per year, with five more basins to be added to the list within the next three decades (World Bank 1999) of the present water usage, 92% is devoted to agriculture, with roughly 3% used in industry and only 5% for domestic purposes like drinking water and sanitation (WRI 2000). With India expected to grow at 8-10%, the demand from the industrial and domestic



sectors is expected to increase with the growing population, urbanization and industrialization and water which is now being used for agriculture will be diverted to urban and industrial use resulting in a tremendous competition and increasing conflict for and over water.

The reliance for water is primarily monsoon centric and where inadequate, surface water (primarily rivers) and groundwater resources are being tapped. This pressing need for water upsets the subtle balance of demand and supply, one which policy options find difficult to manage. Water resource management has been the purview of the State pre and post independence and communities and households are no longer the primary agents of provision and management, thereby leading to manifold problems:

- ◆ Total dependence and monopoly of the state for any kind of water provision
- ◆ Most of India's river basins are degraded
- ◆ Large dams are the major source of water storage, and canals are the major distributory route. The former have caused large-scale community displacement and ecological havoc. The latter, large-scale degradation of land via soil salinisation.
- ◆ Groundwater resources have been heavily over-used.
- ◆ Therefore, in terms of quantity and quality, water provision has been affected interminably and leading to chronic drought like situations in most parts of the country, with the onus of the creation lying squarely on continued government control and no community participation. Despite this India's new National Water Policy 2002 emphasises continued government control over water resources, ignoring pleas by environmental groups to involve local communities in order to overcome looming shortages. Resultantly the role of water management assumes great

importance and significance.

India has over the last 50 years spent \$50 billion on developing water resources and another \$7.5 billion on drinking water with little to show for the money - much of which was siphoned out through a corrupt contractor system. Apart from big dams and irrigation systems, the government has encouraged the digging of millions of tube-wells and bore-wells that now provide half of the country's irrigation, resulting in a dramatic lowering of the water table across the country. Groundwater in states that have taken to intensive agriculture under the so-called Green Revolution of the '70s are now turning brackish or are ridden with fluorides or arsenic. By 1991 a review of the irrigation sector by the World Bank showed that one of the world's largest irrigation investments was performing unevenly and far below potential, mainly because the focus was on construction of new projects rather than management of existing ones. This is expected to be financially unsustainable and infrastructure will be physically unsustainable due to declining construction and maintenance standards. As the World Bank noted, the situation is compounded in some areas by environmental degradation.

Approaches to water management

A fast deteriorating water and environmental scenario, requires that the ever increasing demand supply mismatches are tackled in a crisis management mode and not left to the standard slow-moving bureaucratic and state centric approaches, with slow, little or no perceptible impacts felt.

Traditionally, water resources have not been managed efficiently and effectively. Increasing competition and conflict over water, has time and again emphasised the role of proper management but with the state in a natural monopoly role, this is hardly ever put into practice. The call of the times therefore is to explore innovative approaches to the management of water resources.

It has been observed that this infrastructure-economy interdependency can be enhanced through an approach of increased budgetary allocation alongwith creating and providing an enabling environment for effective public-private participation to enhance availability, delivery and quality of infrastructure services. Infrastructure put in place specifically for water resource management (supply, harvesting etc) therefore needs to be prudently structured for maximum benefit.

Integrated water management despite being the key to the ever widening demand-supply gaps needs to be tuned to increase its efficiency wherin a holistic approach of public policy, implementation, people participation and private participation are all actively involved.

Traditional water management as pointed out earlier relied heavily on the fact that water was a social good and not a private good and hence its management was the prerogative of the state sector as a natural monopoly. However, with inefficiencies and rampant corruption, it's a mockery of management. Privatisation is often resorted to tide over fiscal inadequacies resulting from mis-management but its merely a face saving exercise and does not serve any fruitful purpose. Exclusion of the very segment of population that needs the provision of water most through non-differential pricing beats the entire purpose of equitable distribution of this essential human service. Essentially, therefore removing the anomaly of treating surface water as a public and ground water as a private good needs to be rectified prior to any privatization effort as this will help provision free of exclusion.

A major consequence of water shortage is manifested in terms of the development of a large industry of water vending by small entrepreneurs. The World Bank has given financial aid for the development of such a class of

private enterprise to facilitate privatization efforts of water but sadly such activity has been instrumental in further increasing the exploitation of scarce groundwater resources and hence regulation of ground water resource exploitation is much awaited. While the aid agencies promote water-vending and privatisation, government's apathy in setting up stringent groundwater regulations leaves a convenient loophole for entrepreneurs. Though legally there are no *de jure* rights to groundwater, *de facto* all landowners literally own the groundwater under their land.

Over-exploitation of groundwater has been limited to agriculture until now, but the emerging commercial dimension is laying additional stress on the already dwindling groundwater reserves in the country. Thanks to the World Bank-triggered water sector reform process, trade in water has now been legitimised to such an extent that water utilities in the public domain are switching to profit-making water supply systems, absolving itself of the primary duty of servicing the poor and excluding them.

Over a period of time the so called privatization effort of the multi-lateral institutions like the World Bank have veered considerably from ideological rigidities to pragmatism. The roll-out of privatization of water utilities as an alternative to government mismanagement, has now been increasingly focused on a management contract basis rather than pure privatization as an innovation for private provisioning without excludability of particular user segments and accompanied by accountability and transparency. While this seems like an easy way out yet a lot of issues need to be addressed before such privatization efforts are undertaken. Governments are being prodded into guaranteeing political and sovereign risk and the track record has indicated the monopolization of water provisioning through large MNC entries. NGO and civil society groups



have cautioned that rather than presuming public sector inefficiencies and mismanagement it would be better to think of how to reduce this rather than rampant privatization as a sought after goal.

All of the above indicates very little participation of the community, the entity that consumes the resource itself and who despite his right to have water has not control over its provisioning or its pricing. Community participation in India is a new approach advocated by a lot of NGO's and civil society organizations. It calls for education of the community, the important stakeholders in the entire effort of effective water resource management. The logic behind this approach is that since supply is essentially natural with little control on its availability and distribution, then reducing and rationalizing consumption patterns itself could lead to water conservation and sustained

availability. The National Water Policy, 2006 though ends with the recognition of the need for enhancing and harnessing community participation yet is not emphatic enough to highlight the role it can play in water management methodologies. Integrated water management without a role for community participation is bound to fail in the coming times.

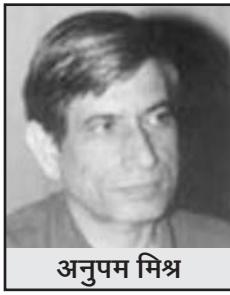
Closing remarks:

Despite the situation looking and turning grim day by day, yet the very fact that people have become conscious of it indicates a ray of hope. However, all efforts to sustainable water provision will come to a naught if caution is not exercised in using privatization as a possible approach for equitable distribution of water. Moreover, without community participation no effort can succeed and will be doomed in its very inception. ■

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संसार सागर के नायक

■ अनुपम मिश्र



अनुपम मिश्र

सैंकड़ों, हजारों तालाब अचानक शून्य से प्रकट नहीं हुए थे। इनके पीछे एक इकाई थी बनवाने वालों की, तो दहाई थी बनाने वालों की। यह इकाई,

दहाई मिलकर

सैंकड़ा हजार बनती। लेकिन पिछले 200 बरसों में नए किसम की थोड़ी-सी पढ़ाई पढ़ गए समाज ने इस इकाई, दहाई, सैंकड़ा, हजार को शून्य ही

खड़ा किया है, आई.आई.टी. का, सिविल इन्जीनियरिंग का, उस पैमाने से, इस काम को नापने की कोई कोशिश नहीं की, जो उनसे पहले हो चुके हैं। वह अपने गज से भी नापता तो कम से कम उसके मन में ऐसे सवाल तो उठते कि उस दौर की आई.आई.टी कहां थी? कौन थे उसके निर्देशक? कितना बजट था, कितने सिविल इन्जीनियरिंग निकलते थे? लेकिन उसने इन सबको गए जमाने का 'गया बीता' काम माना और पानी के प्रश्न को नए ढंग से हल करने का वायदा भी किया और दावा भी।

गाँवों, कस्बों की तो कौन कहे, बड़े शहरों के नलों में चाहे जब बहने वाला सन्नाटा इस वायदे और दावे पर सबसे मुखर टिप्पणी है। इस समय के समाज के दावों को इसी समय के गज से नार्पे

समय में बड़ा नाम था। पूरे देश में तालाब बनते थे और बनाने वाले भी पूरे देश में थे। कहीं यह विद्या जाति के विद्यालय में सिखाई जाती थी तो कहीं यह जात से हट कर एक विशेष पांत भी बन जाती थी। बनाने वाले लोग कहीं एक जगह बसे मिलते थे तो कहीं ये घूम-घूम कर इस काम को करते थे।

गजधर एक सुन्दर शब्द है, तालाब बनाने वालों को आदर के साथ याद करने के लिए। राजस्थान के कुछ भागों में वह शब्द आज भी बाकी है। गजधर यानी जो गज को धारण करता है। और गज वही जो नापने के काम आता है लेकिन फिर भी समाज ने इन्हें तीन हाथ की लोहे की छड़ लेकर घूमने वाला मिस्त्री नहीं माना। गजधर जो समाज की गहराई को नाप लें। उसे ऐसा दर्जा दिया गया है।



बना दिया। इस नए समाज के मन में इतनी भी उत्सुकता नहीं बची कि उससे पहले के दौर में इतने सारे तालाब भला कौन बनाता था, उसने इस तरह के काम को करने के लिए जो नया ढांचा

तो कभी दावे छोटे पड़ते हैं तो कभी गज ही छोटा निकल आता है।

इस गज को अभी यहीं छोड़ें और थोड़ा पीछे लौटें। आज जो अनाम हो गए, उनका एक

गजधर वास्तुकार थे। गांव-समाज हो या नगर-समाज-उसके नव निर्माण की, रख-रखाव की जिम्मेदारी गजधर निभाते थे। नगर नियोजन से लेकर छोटे से छोटे निर्माण के काम गजधर के

कन्धों पर टिके थे। वे योजना बनाते थे, कुल काम की लागत निकालते थे, काम में लगने वाली सारी सामग्री जुटाते थे और इस सबके बदले वे अपने जजमान से ऐसा कुछ मांग बैठते थे, जो वे दे न पाएं। लोग भी ऐसे थे कि उनसे जो कुछ बनता, वे गजधर को भेट कर देते।

काम पूरा होने पर पारिश्रमिक के अलावा गजधर को सम्मान भी मिलता था। सरोपा भेट करना अब शायद सिर्फ सिख परम्परा में ही बचा है पर अभी कुछ ही पहले तक राजस्थान में गजधर को गृहस्थ की ओर से बड़े आदर के साथ सरोपा भेट किया जाता रहा है। पगड़ी बांधने के अलावा चाँदी और कभी-कभी सोने के बटन भी भेट दिए जाते थे। जमीन भी उनके नाम की जाती थी। पगड़ी पहनाए जाने के बाद गजधर अपने साथ काम करने वाली टोली के कुछ और लोगों का नाम बताते थे, उन्हें भी पारिश्रमिक के अलावा यथाशक्ति कुछ न कुछ भेट दी जाती थी। कृतज्ञता का यह भाव तालाब बनने के बाद होने वाले भोज में विशेष रूप से देखने में आता था।

गजधर हिन्दू थे और बाद में मुसलमान भी। सिलावट या सिलावटा नामक एक जाति वास्तुकला में बहुत निष्ठात हुई है। सिलावटा शब्द शिला यानी पत्थर से बना है। सिलावटा भी गजधरों की तरह दोनों धर्मों में थे। आबादी के अनुपात में उनकी संख्या काफी थी। इनके अपने मोहल्ले थे। आज भी राजस्थान के पुराने शहरों में सिलावटापाड़ा मिल जाएंगे। सिंध क्षेत्र में, कराची में भी सिलावटों का भरा-पूरा मोहल्ला है। गजधर और सिलावटा-एक ही काम को करने वाले ये दो नाम कहीं-कहीं एक ही हो जाते थे। जैसलमेर और सिंध में सिलावटों के नायक ही गजधर कहलाते थे। कराची में भी इन्हें सम्मान से देखा जाता था। बंटवारे के बाद पाकिस्तान मंत्रीमण्डल में भी एक सिलावट - हाकिम मोहम्मद गजधर की नियुक्ति हुई थी।

इनकी एक धारा तोमरवंश तक जाती थी और समाज के निर्माण के सबसे ऊँचे पद को भी छूती रही है। अनंगपाल तंवर ने भी कभी दिल्ली पर झण्डा लहराया था। अभ्यस्त आँखों का सुन्दर उदाहरण थे गजधर। गुरु-शिष्य परम्परा से काम सिखाया जाता था। नए हाथ को पुराना हाथ इतना सिखाता, इतना उठाता कि वह कुछ समय बाद 'जोड़िया' बन जाता। जोड़िया यानी गजधर का विश्वसनीय साथी। एक गजधर के साथ कई जोड़िया होते थे। कुछ अच्छे जोड़ियों वाले गजधर स्वयं इतने ऊपर उठ जाते थे कि बस फिर उनका नाम ही गजधर रह जाता, पर गज उनका



जलसूंधा यानी भूजल को 'सूंध' कर बताने वाले लोग भी सिरभाव जैसे ही होते थे पर वे भूजल की तरंगों के संकेत को आम या जामुन की लकड़ी की सहायता से पकड़ कर पानी का पता बताते थे। यह काम आज भी जारी है। दृश्यवैल खोदने वाली क्षणियां फहले अपने यंत्र से जगह चुनती हैं फिर इन्हें बुलाकर और पक्का कर लेती हैं कि पानी मिलेगा या नहीं।

छूट जाता। अच्छे गजधर की एक परिभाषा यही थी कि वे औजारों को हाथ नहीं लगाते। सिर्फ जगह देखकर निर्णय लेते कि वे कहां क्या करना है। वे एक जगह बैठ जाते और सारा काम उनके मौखिक निर्देश पर चलता रहता।

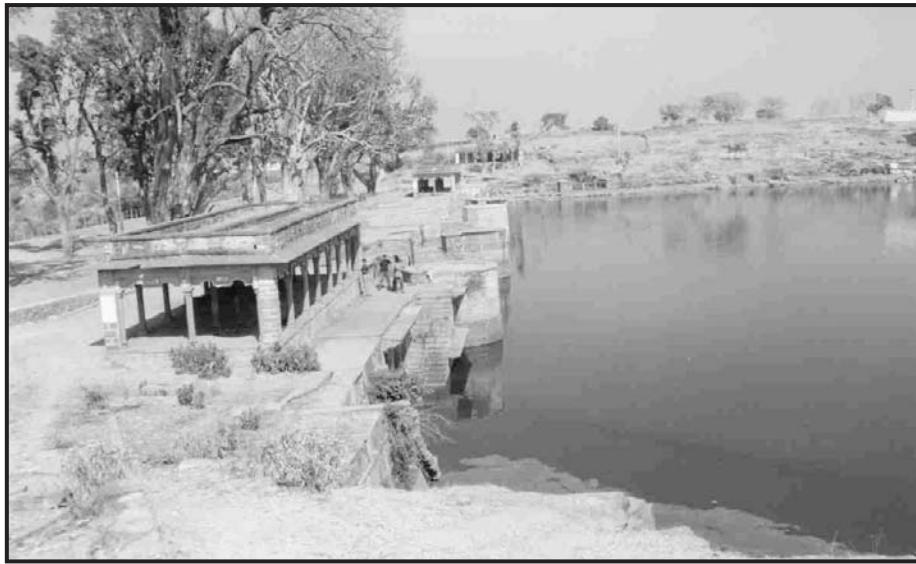
औजारों का उपयोग करते-करते इतना ऊपर उठना कि फिर उनकी जरूरत ही नहीं रहे। यह एक बात है, पर कभी औजारों को हाथ ही नहीं लगाना। यह दूसरी बात है। ऐसे सिद्ध भाव कहलाते थे। सिद्धभाव किसी भी औजार के बिना पानी की ठीक जगह बताते थे। कहते हैं भाव आता था, उन्हें, यानी बस पता चल जाता था। सिद्धभाव कोई जाति विशेष से नहीं होते थे। बस किसी-किसी को यह सिद्धि मिल जाती थी। जलसूंधा यानी भूजल को 'सूंध' कर बताने वाले लोग भी सिद्धभाव जैसे ही होते थे पर वे भूजल की तरंगों के संकेत को आम या जामुन की लकड़ी की सहायता से पकड़ कर पानी का पता बताते थे। यह काम आज भी जारी है। दृश्यवैल खोदने वाली क्षणियां फहले अपने यंत्र से जगह चुनती हैं फिर इन्हें बुलाकर और पक्का कर लेती हैं कि पानी मिलेगा या नहीं। सरकारी क्षेत्रों में भी बिना कागज पर दिखाए इनकी सेवाएं ले ली जाती हैं।

सिलावटा शब्द मध्य प्रदेश तक जाते-जाते एक मात्रा खोकर सिलावट बन जाता है पर गुण ज्यों के त्यों रहते हैं। कहीं-कहीं मध्य-प्रदेश में

सिलावट भी थे। गुजरात में भी इनकी अच्छी आवादी है। वहाँ ये सलाट कहलाते हैं। इनमें हीरा सलाट पत्थर पर अपने काम के कारण बहुत ही प्रसिद्ध हुए हैं। कच्छ में गजधर गईधर हो गए हैं। उनका वंशवृक्ष इन्द्र देवता के पुत्र जयंत से प्रारम्भ होता है। गजधरों का एक नाम सूत्रधार भी रहा है। यही बाद में, गुजरात में ठार और देश के कई भागों में सुथार हो गया। गजधरों का एक शास्त्रीय नाम स्थपति भी था, जो थवई की तरह आज भी प्रचलित है।

पथरोट और टकारी भी पत्थर पर होने वाले सभी कामों के अच्छे जानकर थे और तालाब बनाने के काम में भी लगते थे। मध्यप्रदेश में पथरोटा नाम के गांव और मोहल्ले आज भी इनकी याद दिलाते हैं। टकारी दूर दक्षिण तक फैले थे और इनके मोहल्ले टकेरवाड़ी कहलाते थे।

संसार है माटी का और इस माटी का पूरा संसार जानने वालों की कमी नहीं थी। ये मटकूट थे तो कहीं मटकूड़ा और जहां ये बसते थे, वे गांव मटकूली कहलाते थे। सोनकर और सुनकर शब्द सोने का काम करने वालों के लिए थे। पर यह सोना सोना नहीं, मिट्टी ही था। सोनकर या सुनकर राजलहरिया भी कहलाते थे। ये अपने को रघुवंश के सम्राट सगर के बेटों से जोड़ते थे। अश्वमेध यज्ञ के लिए छोड़े गए घोड़े की चोरी हो जाने पर सगर-पुत्रों ने उसको ढूँढ निकालने के



भील, भिलाले, सहरिया, कोल आज अपना सब कुछ खोकर जनजाति की अनुसूचित सूची में शामिल कर दिए गए हैं पर एक समय में इनके छोटे-बड़े राज थे। इन राज्यों में ये पानी की, तालाबों की पूरी व्यवस्था खुद संभालते थे। बहती नदी का पानी कहां रोक कर कैसा बंधान बांधना है और फिर उस बंधान का पानी कितनी दूर तक सींचने ले जाना है। यह कौशल भील तीर-धनुष की तरह अपने कंधे पर ही रखते थे। इस तरह बांधे गए बंधानों और तालाबों के पानी के दबाव की भी उन्हें खूब परख रहती। दबाव कितना है और कितनी दूरी के कुओं को वह हारा कर देगा, यह भेद वे अपने तीर से रेखा खींच कर बता सकते थे।

लिए सारी पृथ्वी खोद डाली थी और अंत में कपिल मुनि के क्रोध के पात्र बन बैठे थे। उसी शाप के कारण सोनकर तालाबों में मिट्टी खोदने का काम करते थे, पर अब क्रोध नहीं, पुण्य कमाते थे। ये ईंट बनाने के काम में भी बहुत कुशल रहे हैं। खंती भी तालाब में मिट्टी काटने के काम में बुलाए जाते थे। जहाँ ये किसी वजह से न हों, वहाँ कुम्हार से तालाब की मिट्टी के बारे में सलाह ली जाती थी।

तालाब की जगह का चुनाव करते समय बुलई बिना बुलाए आते थे। बुलई यानी वे जिन्हें गांव की पूरी-पूरी जानकारी रहती थी। कहाँ कैसी जमीन है, किसकी है, पहले कहाँ-कहाँ तालाब, बावड़ी आदि बन चुके हैं, कहाँ और बन सकते हैं। ऐसी सब जानकारियों बुलई को कंठस्थ रहती थी, फिर भी उसके पास इस सबका बारीक हिसाब-किताब लिखा भी मिलता था। मालवा के इलाकों में बुलई की मदद से ही यह सब जानकारी रकबे में बाकायदा दर्ज की जाती थी और यह रकबा हरेक जर्मीदारी में सुरक्षित रहता था।

बुलई कहीं ढेर भी कहलाते थे और इसी तरह मिर्धा थे, जो जमीन की नाप-जोख, हिसाब-किताब और जमीन के झगड़ों का निपटारा भी करते थे। ईंट और चूने के गारे का काम चुनकर करते थे। बचे समय में नमक का भी व्यापार इन्हीं के हाथ होता था। आज के मध्य प्रदेश में सन् 1911 में चुनकरों का आवादी 24000 से ऊपर थी। उधर उड़ीसा में लुनिया, मुरहा और सांसिया थे। अंग्रेज के समय सांसियों को अपराधी जाति बताकर पूरी तरह तोड़ दिया गया था।

नए लोग जैसे तालाबों को भूलते गए, वैसे ही उनको बनाने वालों को भी। भूले-बिसरे लोगों की

सूची में लड़िया, दुसाध, नौनिया, गोंड, परधान, कोल, ढीमर, ढीवर, भोई भी आते हैं। एक समय था जब ये तालाब के अच्छे जानकर माने जाते थे। आज इनकी उस भूमिका को समझने के विवरण भी हम खो बैठे हैं।

कोरी या कोली जाति ने भी तालाबों का बड़ा काम किया था। सैंकड़ों तालाब बनाने वाले कोरियों के बारे में आज ठीक ढंग की जानकारी देने वाली एक पंक्ति भी नहीं मिल पाती। लेकिन एक समय था जब बहुत से क्षेत्र कोली जाति के सदस्यों को अपने यहाँ बसाने के लिए कई तरह की सुविधाएं जुटाते थे। महाराष्ट्र-गुजरात के अनेक गाँवों में उन्हें जो जमीन दी जाती थी, उसका लगान माफ कर दिया जाता था। ऐसी जमीन बारा या बारो कहलाती थी।

सच्चमुच लौह पुरुष थे अगरिया। यह जाति लोहे के काम के कारण जानी जाती थी। पर कहीं-कहीं अगरिया तालाब भी बनाते थे। तालाब खोदने के औजार-गेंती, फावड़ा, बेल, मेटाक, तसले या तगारी बनाने वाले लोग उन औजारों को चलाने में भी किसी से पीछे नहीं थे। बेल से ही बेलदार शब्द बना है।

माली समाज और इस काम में लगी परिहार जाति का भी तालाब बनाने में, तालाब बनाने पर उसमें कमल, कुमुदिनी लगाने में योगदान रहता था। कहीं-कहीं तालाब के किनारे की कुछ जमीन केवल माली परिवारों के लिए सुरक्षित रखी जाती थी। उनका जीवन तालाब से चलता था और जीवनभर वे तालाब की रखवाली करते थे।

भील, भिलाले, सहरिया, कोल आज अपना सब कुछ खोकर जनजाति की अनुसूचित

सूची में शामिल कर दिए गए हैं पर एक समय में इनके छोटे-बड़े राज थे। इन राज्यों में ये पानी की, तालाबों की पूरी व्यवस्था खुद संभालते थे। बहती नदी का पानी कहां रोक कर कैसा बंधान बांधना है और फिर उस बंधान का पानी कितनी दूर तक सींचने ले जाना है। यह कौशल भील तीर-धनुष की तरह अपने कंधे पर ही रखते थे। इस तरह बांधे गए बंधानों और तालाबों के पानी के दबाव की भी उन्हें खूब परख रहती। दबाव कितना है और कितनी दूरी के कुओं को वह हरा कर देगा, यह भेद वे अपने तीर से रेखा खींच कर बता सकते थे।

राजस्थान में यह काम मीणा करते थे। अलवर जिले में एक छोटी-सी नई संस्था 'तरुण भारत संघ' ने पिछले 20 वर्षों में 7500 से अधिक तालाब बनाए हैं। उसे हर गांव में यही लगा कि पूरा गांव तालाब बनाना जानता है। कठिन से कठिन मामलों में संस्था को बाहर से कोई सलाह नहीं लेनी पड़ी क्योंकि भीतर तो मीणा थे जो पीढ़ियों से यहाँ तालाब बनाते रहे हैं। भीलों में कई भेद थे। नायक, नायका, चोलीवाला नायक, कापड़िया नायक, बड़ा नायक, छोटा नायक और फिर तलाविया, गरासिया-सब तालाब और पानी के काम के नायक माने जाते थे।

नायक या महाराष्ट्र कोंकण में नाई उपाधि, बंजारा समाज में भी थी। वन में विचरने वाले बनचर, बिनचर धीरे-धीरे बंजारे कहलाने लगे। ये आज दयनीय बना दिए गए हैं, पर एक समय ये एक शहर से दूसरे शहर सैंकड़ों पशुओं पर माल लाद कर व्यापार करने निकलते थे। गन्ने के क्षेत्र से धान के क्षेत्र में गुड़ ले जाते और फिर धान लाकर दूसरे क्षेत्रों में बेचते थे।

शाहजहां के बजीर आसफजहाँ जब सन् 1630 में दक्खन आए थे तो उनकी फौज का सामान भंगी-जंगी नाम के नायक बंजारों के बैलों पर लदा था। बैलों की संख्या थी एक लाख अस्सी हजार। भंगी-जंगी के बिना शाही फौज हिल नहीं सकती थी। उनकी प्रशंसा में बजीर आसफजहाँ ने उन्हें सोने से लिखा एक ताम्रपत्र भेंट किया था।

वर्णनों में कुछ अतिशयोक्ति होगी पर इनके कारवां में पशु इतने होते कि गिनना कठिन हो जाता था। तब इसे एक लाख पशुओं का कारवां मान लिया जाता था और ऐसी टोली का नायक लाखा बंजारा कहलाता था। हजारों पशुओं के इस कारवां को सैंकड़ों लोग लेकर चलते थे। इसके एक दिन के पड़ाव पर पानी की किटनी मांग होती, इसका अंदाज लगाया जा सकता है। जहाँ ये जाते, वहाँ अगर पहले से बना तालाब नहीं होता तो फिर वहाँ तालाब बनाना वे अपना कर्तव्य मानते। मध्य प्रदेश के सागर नाम की जगह में बना सुन्दर और बड़ा तालाब ऐसे ही किसी लाखा बंजारे ने बनाया था। छत्तीसगढ़ में आज भी कई गाँवों में लोग अपने तालाब को किसी लाखा बंजारे से जोड़ कर याद करते हैं। इन अज्ञात लाखा बंजारों के हाथों से बने ज्ञात तालाबों की सूची में कई प्रदेशों के नाम समा जाएंगे।

गोंड समाज का तालाबों से गहरा सम्बन्ध रहा है। महाकौशल में गोंड का यह गुण जगह-जगह तालाबों के रूप में विखरा मिलेगा। जबलपुर के पास कूड़न द्वारा बनाया गया। ताल आज कोई एक हजार बरस बाद भी काम दे रहा है। इसी समाज में रानी दुर्गावती हुई, जिनने अपने छोटे से काल में एक बड़े भाग को तालाबों से भर दिया था।

गोंड न सिर्फ खुद तालाब बनाते-बनवाते थे, बल्कि तालाब बनाने वाले दूसरे लोगों का भी खुब सम्मान करते थे। गोंड राजाओं ने उत्तर भारत से कोहली समाज के लोगों को आज के महाराष्ट्र के भण्डारा जिले में उत्साह के साथ लाकर बसाया था। भण्डारा में भी इसी कारण बहुत अच्छे तालाब मिलते हैं।

बड़े तालाबों की गिनती में सबसे पहले आने वाला प्रसिद्ध भोपाल ताल बनवाया तो राजा भोज ने था पर इसकी योजना भी कालिया नामक एक गोंड सरदार की मदद से ही पूरी हो सकी थी। भोपाल-होशंगाबाद के बीच की घाटी में बहने वाली कालिया सोत नदी इन्हीं गोंड सरदार के नाम से याद की जाती है।

ओडिया, ओढ़ही, ओरही, ओड़, औड़-

जैसे-जैसे जगह बदली, वैसे-वैसे इनका नाम बदलता था पर काम एक ही था, दिन-रात तालाब और कुएं बनाना। इतने कि गिनना सम्भव न बचे। ऐसे लोगों के लिए ही कहावत बनी थी कि ओड़ हर रोज नए कुएं से पानी पीते हैं। बनाने वाले और बनने वाली चीज के एकाकार होने का इससे अच्छा उदाहरण शायद ही मिले क्योंकि कुएं का एक नाम ओड़ भी है। ये पश्चिम में ठेठ गुजरात से राजस्थान, उत्तरप्रदेश, विशेषकर बुलन्दशहर और उसके आसपास के क्षेत्र, महाराष्ट्र, मध्यप्रदेश, उड़ीसा तक फैले थे। इनकी संख्या भी काफी रही होगी। उड़ीसा में कभी कोई संकट आने पर नौ लाख ओडियों के धार नगरी में पहुँचने की कहानी मिलती है। ये गधे पालते थे। कहीं ये गांवों से मिट्टी ढोकर केवल पाल बनाते थे, तो कहीं तालाब की मिट्टी काटते थे। प्रायः स्त्री-पुरुष एक साथ काम करते थे। ओढ़ी मिट्टी के अच्छे जानकर होते थे। मिट्टी के रंग और मिट्टी की गंध से स्वभाव पढ़ लेते थे। मिट्टी की सतह और दबाव भी खूब पहचानते थे। राजस्थान में तो आज भी कहावत है कि ओढ़ी कभी दब कर नहीं मरते।

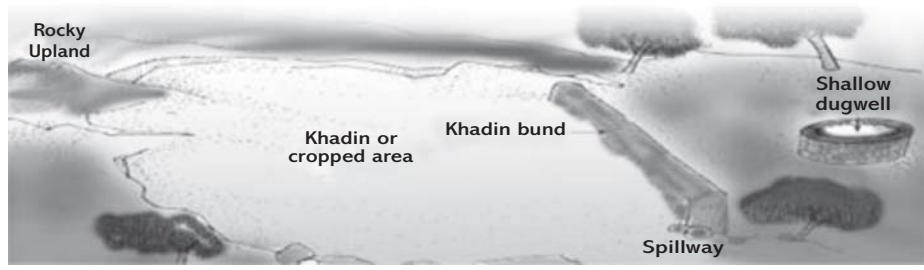
प्रसिद्ध लोकनायिका जसमा ओढ़न धार नगरी के ऐसे ही एक तालाब पर काम कर रही थी, जब राजा भोज ने उसे देख अपना राज-पाट तक छोड़ने का फैसला ले लिया था। राजा ने जसमा को सोने से बनी एक अप्सरा की तरह देखा था। पर ओढ़ी परिवार में जन्मी जसमा अपने को, अपने शरीर को तो क्या संसार तक को मिट्टी मानने वाली परम्परा का हिस्सा थी। किस्सा बताता है कि राजा जसमा को पाने के लिए कुछ भी करने को तैयार था, अपने कर्तव्य को छोड़ कर जो नहीं करने लायक मृत्यु का वरण करना तय करती है। राजा का नाम मिट गया पर जसमा, ओढ़न का जस आज भी उड़ीसा से लेकर छत्तीसगढ़, महाकौशल, मालवा, राजस्थान और गुजरात में फैला हुआ है। सैंकड़ों बरस बीत गए हैं, इन हिस्सों में फसल कटने के बाद आज भी रात-रात भर जसमा ओढ़न के गीत गए जाते हैं, नौटंकी खेली जाती है। भवई के

मंचों से लेकर भारत भवन, राष्ट्रीय नाट्य विद्यालय तक में जसमा के चरण पड़े हैं।

जसमा ओढ़न का यश तो लोगों के मन में बाकी रहा पर ओडियों का तालाब और कुएं वाला यश नए लोगों ने भुला दिया है। जो सचमुच राष्ट्र निर्माता थे, उन्हें अनिश्चित रोजी-रोटी की तलाश में भटकने के लिए मजबूर कर दिया गया है। कई ओढ़ी आज भी वही काम करते हैं-इंदिरा नहर को बनाने में हजारों ओढ़ी लगे थे-पर जस चला गया है उनका। उड़ीसा में ओडियों के अलावा, सोनपुरा और महापात्रे भी तालाब और कुएं के निर्माता रहे हैं। ये गंजाम, पुरी, कोणार्क और आसपास के क्षेत्रों में फैले थे। सोनपुरा बालंगीर जिले के सोनपुर गांव से निकले लोग थे। एक तरफ ये मध्य प्रदेश जाते थे तो दूसरी तरफ नीचे आन्ध्र तक। खरिया जाति, रामगढ़, बिलासपुर और सरगुजा के आसपास तालाब, छोटे बांध और नहरों का काम करती थी। 1872 की जनगणना में इनकी संख्या 23 हजार थी।

बिहार में मुसहर, बिहार से जुड़े उत्तर प्रदेश के हिस्सों में लुनिया, मध्य प्रदेश में नौनिया, दुसाध और कोल जाति भी तालाब बनाने में मग्न रहती थी। मुसहर, लुनिया और नौनिया तब आज जैसे लाचार नहीं थे। 18वीं सदी तक मुसहरों को तालाब पूरा होने पर उचित पारिश्रमिक के साथ-साथ जमीन भी दी जाती थी। नौनिया, लुनिया की तालाब बनाने पर पूजा होती थी। मिट्टी के पारखी मुसहर का समाज में अपना स्थान था। चोहरमल उनके एक शक्तिशाली नेता थे किसी समय। श्री सलेस (शैलेष) दुसाध के पूज्य थे। इनके गीत जगह-जगह गाए जाते हैं और इन्हें दूसरे लोग भी इज्जत देते हैं। दुसाध जब श्री सलेस के यज्ञ करते हैं तो अन्य जातियों के लोग उसमें लेते हैं।

इन्हीं इलाकों में बसी थी डांडी नामक एक जाति। यह कठिन और मेहनती काम करने के लिए प्रसिद्ध थी और इस सूची में तालाब और कुओं तो शामिल था ही। बिहार में आज भी किसी कठिन काम का ठीक हल न सूझे तो कह देते हैं, “डांडी लगा दो।” डांडी बहुत ही सुन्दर मजबूत



इन ब्राह्मणों को मरुभूमि में बरसने वाले थोड़े से पानी को पूरी तरह से रोक लेने का अच्छा कौशल सध गया था। वे खड़ीन के अच्छे निर्माता थे। मरुभूमि का कोई ऐसा बड़ा टुकड़ा जहां पानी बह कर आता हो, वहां दो या तीन तरफ से मेंडबंदी कर पानी रोक कर विशिष्ट ढंग से तैयार बांधनुमा खेत को खड़ीन कहा जाता है। खड़ीन खेत बाद में है, पहले तो तालाब ही है। मरुभूमि में सेंकड़ों मन अनाज इन्हीं खड़ीनों में पैदा किया जाता रहा है। आज भी जोधपुर, जैसलमेर, बाड़मेर क्षेत्र में सैकड़ों खड़ीन खड़ी हैं।

काठी की जाति थी। इस जाति के सुडौल, गठीले शरीर मछली, मांसपेशी गिनने का न्यौता देते थे।

आज के बिहार और बंगला में बसे संथाल भी सुन्दर तालाब बनाते थे। संथाल की कुशलता की याद दिलाने खड़े हैं। महाराष्ट्र के नासिक क्षेत्र में कोहलियों के हाथों इतने बंधान और तालाब बने थे कि इस हिस्से पर अकाल की छाया नहीं पड़ती थी। समुद्र तटवर्ती गोवा और कोंकण प्रदेश घनघोर वर्षा के क्षेत्र हैं। पर यहाँ वर्षा का मीठा पानी देखते ही देखते खारे पानी के विशाल समुद्र में मिल जाता है। यह गावड़ी जाति की ही कुशलता थी कि पश्चिम घाट की पहाड़ियों पर ऊपर से नीचे तक कई तालाबों में वर्षा का पानी वर्ष भर रोककर रखा जाता था। यहाँ और इससे ही जुड़े कर्नाटक के उत्तरी कन्नड़ क्षेत्र में चीरे नामक पत्थर मिलता है। तेज बरसात और बहाव को इसी पत्थर के सहारे बांधा जाता है। चीरे पत्थर को खानों से निकाल कर एक मानक आकार में तराशा जाता रहा है। इस आकार में रक्ती भर परिवर्तन नहीं आया है।

इतना व्यवस्थित काम बिना किसी व्यवस्थित ढांचे के नहीं हो सकता था। बुद्धि और संगठन का एक ठीक तालमोल खड़े किए बिना देश में इतने सारे तालाब न तो बन सकते थे, न टिक ही सकते थे। यह संगठन कितना चुरस्त, दुरुस्त रहा होगा, इस प्रश्न का उत्तर दक्षिण की एक झलक से मिलता है।

दक्षिण में सिंचाई के लिए बनने वाले तालाब एरी कहलाते हैं। गाँव-गाँव में एरी थीं और उपेक्षा के 200 वर्षों के इस दौर के बावजूद इनमें से हजारों ऐरियां आज भी सेवा कर रही हैं। गाँव में पंचायत के भीतर ही एक और संरथा होती थी। एरी वार्यम्। एरी वार्यम् में गाँव के छह सदस्यों की एक वर्ष के लिए नियुक्ति होती थी। एरी से सम्बन्धित हरेक काम-एरी बनाना, उसका रखरखाव, सिंचाई की उचित और निष्पक्ष व्यवस्था और इन सब कामों के लिए सतत् साधन जुटाना वार्यम् के जिम्मे होता था। वार्यम् के छह सदस्य इन कामों को ठीक से नहीं कर पाएं तो उन्हें नियुक्ति की अवधि से पहले भी हटाया जा सकता था।

यहाँ एरी बनाने का काम वोद्दार करते

थे। सिंचाई की पूरी व्यवस्था के लिए एक पद होता था। इसे अलग-अलग क्षेत्र में नीरघंटी, नीरगंटी नीरआनी, कंबकट्टी और माझयन थोट्टी के नाम से जाना जाता था। तालाब में कितना पानी है, कितने खेतों में सिंचाई होनी है, पानी का कैसा बंटवारा करना है-ये सारे काम नीरघंटी करते थे। नीरघंटी का पद अनेक क्षेत्रों में सिर्फ हरिजन को ही दिया जाता था और सिंचाई के मामले में उनका निर्णय सर्वोपरि होता था। किसान कितना भी बड़ा कर्यों न हो, इस मामले में नीरघंटी से छोटा ही माना जाता था।

एक तरफ दक्षिण में नीरघंटी जैसे हरिजन थे तो पश्चिम में पालीवाल जैसे ब्राह्मण भी थे। जैसलमेर, जोधपुर के पास 10वीं सदी में पल्ली नगर में बसने के कारण ये पल्लीवाल या पालीवाल कहलाए। इन ब्राह्मणों को मरुभूमि में बरसने वाले थोड़े से पानी को पूरी तरह से रोक लेने का अच्छा कौशल सध गया था। वे खड़ीन के अच्छे निर्माता थे। मरुभूमि का कोई ऐसा बड़ा टुकड़ा जहां पानी बह कर आता हो, वहां दो या तीन तरफ से मेंडबंदी कर पानी रोक कर विशिष्ट ढंग से तैयार बांधनुमा खेत को खड़ीन कहा जाता है। खड़ीन खेत बाद में है, पहले तो तालाब ही है। मरुभूमि में सैकड़ों मन अनाज इन्हीं खड़ीनों में पैदा किया जाता रहा है। आज भी जोधपुर, जैसलमेर, बाड़मेर क्षेत्र में सैकड़ों खड़ीन खड़ी हैं।

लेकिन पानी के काम के अलावा स्वाभिमान भी क्या होता है, इसे पालीवाल ही जानते थे। जैसलमेर में न जाने कितने गाँव पालीवालों के थे। राजा से किसी समय विवाद हुआ। बस, रातों-रात पालीवालों के गाँव खाली हो गए। एक से एक कीमती, सुन्दर घर, कुएं, खड़ीन सब छोड़कर पालीवाल राज्य से बाहर हो गए। आज उनके वीरान गाँव और घर जैसलमेर में पर्यटक को गाइड बड़े गर्व से दिखाते हैं। पालीवाल वहां से निकल कर कहाँ-कहाँ गए, इसका ठीक अंदाज नहीं है पर एक मुख्य धारा आगरा और जौनपुर में जा बसी थी।

महाराष्ट्र में चितपावन ब्राह्मण भी तालाब बनाने से जुड़े थे। कुछ दूसरे ब्राह्मणों को यह ठीक नहीं लगा कि ब्राह्मण मिट्टी खोदने और

ढोने के काम में लगें। कथा है वासुदेव चित्तले नामक चितपावन ब्राह्मण की। वासुदेव ने कई तालाब, बावड़ी और कुएं बनाए थे। जब वे परशुराम क्षेत्र में एक बड़ा सरोवर बना रहे थे और उनके कारण अनेक ब्राह्मण भी मिट्टी खोद रहे थे तो देवरुख नामक स्थान से आए ब्राह्मणों के एक समूह ने उनका विरोध किया। तब वासुदेव ने उन्हें शाप दिया कि जो भी ब्राह्मण तुम्हारा साथ देंगे वे तेजहीन होकर लोगों की निंदा के पात्र बनेंगे। उस चितपावन के शाम से बाद में ये लोग देवरुख ब्राह्मण तेजहीन हुए कि नहीं, लोक निंदा बने कि नहीं, पता नहीं। लेकिन चितपावन ब्राह्मण अपने क्षेत्र में और देश में भी हर मामले में अपनी विशेष पहचान बनाए रहे हैं।

कहा जाता है कि पुष्करण ब्राह्मणों को भी तालाब ने ही उस समय समाज में ब्राह्मण का दर्जा दिलाया था। जैसलमेर के पास पोकरन में रहने वाला यह समूह तालाब बनाने का काम सौंपा गया था। रेत से घिरे बहुत कठिन क्षेत्र में इन लोगों ने दिन रात एक करके सुन्दर तालाब बनाया। जब वह भरा तो प्रसन्न होकर इन्हें ब्राह्मण का दर्जा दिया गया। पुष्करण ब्राह्मणों के यहाँ कुदाल रूपी मूर्ति की पूजा की जाती रही है।

अपने पूरे शरीर पर राम नाम का गुदना गुदाने और राम-नाम की चादर ओढ़ने वाले छत्तीसगढ़ के रामनामी तालाबों के अच्छे जानकार थे। मिट्टी का काम राम का ही नाम था इनके लिए। रायपुर, विलासपुर और रायगढ़ जिलों में फैले इस संप्रदाय के लोग छत्तीसगढ़ क्षेत्र में घूम-घूम कर तालाब खोदते रहे हैं। सम्भवतः इस घूमने के कारण ही इन्हें बंजारा भी मान लिया गया था। छत्तीसगढ़ में कई गांवों में लोग यह कहते हुए मिल जाएंगे कि उनका तालाब बंजारों ने बनाया था। रामनामी परिवारों में दफनाया जाता था क्योंकि उनके लिए मिट्टी से बड़ा और कुछ नहीं। जीवन-भर राम का नाम लेकर तालाब का, मिट्टी का काम करने वाले के लिए जीवन के पूर्ण विराम की इससे पवित्र और कौन-सी रीति होगी?

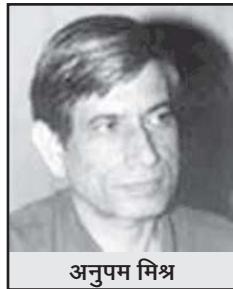
आज ये सब नाम अनाम हो गए हैं। उनके नामों को स्मरण करने की यह नाम-माला, गजधर से लेकर रामनामी तक की नाम-माला अधूरी ही है। सब जगह तालाब बनते थे और सब जगह उन्हें बनाने वाले लोग थे। सैकड़ों, हजारों तालाब शून्य में से प्रकट नहीं हुए थे। लेकिन उन्हें बनाने वाले लोग आज शून्य बना दिए गए हैं।

(लेखक सुप्रसिद्ध गाँधीवादी चिंतक हैं।)

मृगतृष्णा झुठलाते तालाब



■ अनुपम मिश्र



अनुपम मिश्र

देशभर में पानी का काम करने वाला यह माथा रेगिस्तान में मृगतृष्णा से घिर गया था। सबसे गरम और सबसे सूखा क्षेत्र है यह। साल भर में कोई 3 इंच से 12 इंच पानी बरसता है यहाँ। जैसलमेर, बाड़मेर और बीकानेर के कुछ भागों में कभी-कभी पूरे वर्ष में बस इतना ही पानी गिरता है, जितना देश के अन्य भागों में एक दिन में गिर जाता है। सूरज भी यही सबसे ज्यादा चमकता है और अपनी पूरी तेजी के साथ। गरमी की ऋटु लगता है, यहाँ से देश में प्रवेश करती है और बाकी राज्यों में अपनी हाजिरी लगाकर फिर यहीं रम जाती है। तापमान 50 अंश न छू ले तो मरुभूमि के लोगों के मन में उसका सम्मान कम

हो जाता है। भूजल भी यहीं सबसे गहरा है। जल के अभाव को ही मरुभूमि का स्वभाव माना गया है। लेकिन यहाँ के समाज ने इसे एक अभिशाप की तरह नहीं, बल्कि प्रकृति के एक बड़े खेल के हिस्से की तरह देखा और फिर वह एक कुशल पात्र की तरह सजधज कर उस खेल में शामिल हो गया।

चारों तरफ मृगतृष्णा से घिरी तपती मरुभूमि में जीवन की, एक जीवंत संस्कृति की नींव रखते समय इस समाज ने पानी से सम्बन्धित छोटी से छोटी बात को देखा-परखा होगा। पानी के मामले में हर विपरीत परिस्थिति में उसने जीवन की रीत खोजने का प्रयत्न किया और मृगतृष्णा को झुठलाते हुए जगह-जगह तरह-तरह के प्रबन्ध किए।

जहाँ तालाब नहीं, पानी नहीं, वहां गाँव नहीं। तालाब का काम पहले होगा तब उसको आधार बनाकर गाँव बसेगा। मरुभूमि में सेंकड़ों गाँवों का नामकरण वहाँ बने तालाबों से जुड़ा है। बीकानेर जिले की बीकानेर तहसील में 64, कोलायत तहसील में 20 और नौखा क्षेत्र में

123 गाँवों के नाम 'सर' पर आधारित हैं। एक तहसील लूणकरणसर के नाम में ही सर है और यहाँ अन्य 85 गाँवों का नामकरण सर पर है। बचे जिन गाँवों के नाम में सर नहीं है, उन गाँवों में भी तालाब जरूर मिलेंगे। हाँ दो-चार ऐसे भी गाँव हैं, जिनके नाम में सर है लेकिन वहाँ सरोवर नहीं है। गाँव में सरोवर बन जाए-ऐसी इच्छा गाँव के नामकरण के समय रहती ही थी, ठीक उसी तरह जैसे बेटे का नाम रामकुमार, बेटी का नाम पार्वती आदि रखते समय माता-पिता अपनी संतानों में इनके गुणों की कामना कर लेते हैं।

अधिकांश गाँवों में पूरा किया जा चुका कर्तव्य और जहाँ कहीं किसी कारण से पूरा न हो पाए, उसे निकट भविष्य में पूरा होते देखने की कामना ने मरुभूमि के समाज को पानी के मामले में एक पक्के संगठन में ढाल दिया था। राजस्थान के ग्यारह जिलों-जैसलमेर, बाड़मेर, जोधपुर, पाली, बीकानेर, चुरू, श्रीगंगानगर, झुन्झुनू, जालौर, नागौर और सीकर में मरुस्थल का विस्तार मिलता है। लेकिन मरुस्थल अपने को समेट कर सघन बनता है

संग्रह और किफायत के इस स्वभाव को न समझ पाने वाले गजेटियर और जिनका वे प्रतिनिधित्व करते हैं, उस राज और समाज को यह क्षेत्र 'वीरान, वीभत्स, स्फूर्तिहीन और जीवनहीन' दिखता है। लेकिन गजेटियर में यह सब लिख जाने वाला भी जब घड़सीसर पहुँचा है तो 'वह भूल जाता है कि वह मरुभूमि की यात्रा पर है। कागज में, पर्यटन के नक्शों में जितना बड़ा शहर जैसलमेर है, लगभग उतना ही बड़ा तालाब घड़सीसर है। कागज की तरह मरुभूमि में भी ये एक दूसरे से सटे खड़े हैं- बिना घड़सीसर के जैसलमेर नहीं होता। लगभग 800 बरस पुराने इस शहर के कोई 700 बरस, उसका एक-एक दिन घड़सीसर की एक-एक बूँद से जुड़ा रहा है।

रेत का एक विशाल टीला सामने खड़ा है। पास पहुँचने पर भी समझ नहीं आएगा कि यह टीला नहीं, घड़सीसर की ऊँची-पूरी लम्बी-चौड़ी पाल है। जरा और आगे बढ़ें तो दो बुर्ज और पत्थर पर सुन्दर नकाशी के पाँच झरोखों और दो छोटी और एक बड़ी पोल का प्रवेश द्वार सिर उठाए खड़ा दिखेगा। बड़ी और छोटी पोलों के सामने नीला आकाश झलकता है। जैसे-जैसे कदम आगे बढ़ते जाते हैं, प्रवेश द्वार से दिखने वाली झलक में नए-नए दृश्य जुड़ते जाते हैं। यहाँ तक पहुँच कर समझ में आएगा कि पोल से जो नीला आकाश दिख रहा था, वह तो सामने फैला नीला पानी है। फिर दाईं-बाईं तरफ सुन्दर पक्के घाट, मन्दिर, पठियाल, बारादरी, अनेक स्तंभों से सजे बरामदे, कमरे तथा और न जाने क्या-क्या जुड़ जाता है। हर क्षण बदलने वाले दृश्य पर जब तालाब के पास पहुँच कर विराम लगता है, तब आँखे सामने दिख रहे सुन्दर दृश्य पर कहीं एक जगह टिक नहीं पाती। हर क्षण पुतलियां धूम-धूम कर उस विचित्र दृश्य को नाप लेना चाहती हैं। पर आँखें इसे नाप नहीं पाती। तीन मील लम्बे और कोई एक मील चौड़े आगर वाले इस तालाब का आगौर 120 वर्गमील क्षेत्र में फैला हुआ है। इसे जैसलमेर के राजा महारावल घड़सी ने बनवाया करते थे, लेकिन घड़सी ने तो खुद इसे बनाया था। महारावल रोज ऊँचे किले से उत्तर कर यहाँ आते और खुदाई, भराई आदि हरेक काम की देखरेख करते। यों वह दौर जैसलमेर राज के लिए भारी उथल-पुथल का दौर था। भाटींश गद्दी की छीनाझपटी के लिए भीतरी कलह, घड़यंत्र और संघर्ष से गुजर रहा था। मामा अपने भानजे पर घात लगाकर आक्रमण कर रहा था, सगे भाई को देश निकाला दिया जा रहा था तो कहीं किसी के प्याले में जहर घोला जा रहा था।

राजवंश में आपसी कलह तो थी ही, उधर राज और शहर जैसलमेर भी चाहे जब देशी-विदेशी हमलावरों से घिर जाता था और जब-तब पुरुष वीर गति को प्राप्त होते और स्त्रियां जौहर की ज्वाला में अपने को स्वाहा कर देतीं। ऐसे धधकते दौर में खुद घड़सी ने राठोरों की सेना की मदद से जैसलमेर पर अधिकार किया था। इतिहास की किताबों में घड़सी का काल जय-पराजय, वैभव-पराभव, मौत के घाट और समर सागर जैसे शब्दों से भरा पड़ा है। तब भी यह सागर बन रहा था। वर्षों की इस योजना पर काम करने के लिए घड़सी ने अपार धीरज और अपार साधन जुटाए और फिर इसकी सबसे बड़ी कीमत भी चुकाई थी। पाल बन रही थी, महारावल पाल पर खड़े होकर सारा काम देख रहे थे। राज परिवार में चल रहे भीतरी घड़यंत्र ने पाल पर खड़े घड़सी पर घातक हमला किया। राजा की चिन्ता पर रानी का सती हो जाना उस समय का चलन था। लेकिन रानी विमला सती नहीं हुई। राजा का सपना रानी ने पूरा किया।

रेत के इस सपने में दो रंग हैं। नीला रंग है पानी का और पीला रंग है तीन-चार मील के तालाब की कोई आधी गोलाई में बने घाट, मन्दिरों, बुर्ज और बारादरी का। लेकिन यह सपना दिन में दो बार बस केवल एक ही रंग में रंगा दिखता है। उगते और ढूबते समय सूरज घड़सीसर में मन-भर पिघला सोना उंडेल देता है। मन-भर यानी माप-तोल वाला मन नहीं, सूरज का मन भर जाए इतना। लोगों ने भी घड़सीसर में अपने-अपने सामर्थ्य से सोना डाला था। तालाब राजा का था पर प्रजा उसे संवारती, सजाती चली गई। पहले दौर में बने मन्दिर, घाट और जलमहल का विस्तार होता गया। जिसे जब भी जो कुछ अच्छा सूझा, उसे उसने घड़सीसर में न्यौछावर कर दिया। घड़सीसर राजा-प्रजा की उस जुगलबंदी में एक अद्भूत गीत बन गया था।

एक समय घाट पर पाठशालाएं भी बनीं। इनमें शहर और आसपास के गाँवों के छात्र आकर रहते थे और वहीं गुरु से ज्ञान पाते थे। पाल पर एक तरफ छोटी-छोटी रसोइयां और कमरे भी हैं। दरबार में, कचहरी में जिनका कोई काम अटकता, वे गाँवों से आकर यहीं डेरा जमाते। नीलकंठ और गिरधारी के मन्दिर बने। यज्ञशाला बनी। जमालशाह पीर की चौकी बनी। सब एक घाट पर। काम-धंधे के कारण मरुभूमि छोड़कर देश में कहीं और जा बसे परिवारों का मन भी घड़सीसर में अटका रहता।

इसी क्षेत्र से मध्य प्रदेश के जबलपुर में जाकर रहने लगे सेठ गोविन्ददास के पुरखों ने यहाँ लौटकर पटसाल पर एक भव्य मन्दिर बनवाया था। पानी तो शहर-भर का यहीं से जाता था। यों तो दिन-भर यहाँ से पानी भरा जाता लेकिन सुबह और शाम तो सेंकड़ों पनिहारिनों का मेला लगता। यह दृश्य शहर में नल आने से पहले तक रहा है। सन् 1919 में घुड़सीसर पर उम्मेदसिंह जी मेहता की एक गजल ऐसे दृश्यों का बहुत सुन्दर वर्णन करती है। भादों की कजली-तीज के मेले पर सारा शहर सज-धज कर घड़सीसर आ जाता। सिफ़ नीले और पीले रंग के इस तालाब में तब प्रकृति के सब रंग छिटक जाते। घड़सीसर से लोगों का प्रेम एकत्रफा नहीं था। लोग घड़सीसर आते और घड़सीसर भी लोगों तक जाता था और उनके मन में बस जाता। दूर सिंध में रहने वाली टीलों नामक गणिका के मन ने सम्भवतः ऐसे ही किसी क्षण में कुछ निर्णय ले लिए थे।

तालाब पर मन्दिर, घाट-पाट सभी कुछ था। ठाट में कोई कमी नहीं थी। फिर भी टीलों को लगा कि इतने सुनहरे सरोवर का एक सुनहरा प्रवेश द्वार भी होना चाहिए। टीलों ने घड़सीसर के पश्चिमी घाट पर 'पोल' यानी प्रवेश द्वार बनाना तय कर लिया। पत्थर पर बारीक नकाशी वाले सुन्दर झरोखों से युक्त विशाल द्वार अभी पूरा ही हो रहा था कि कुछ लोगों ने महाराज के कान भरे, ''क्या आप एक गणिका द्वारा बनाए गए प्रवेश द्वार से घुड़सीसर में प्रवेश किया करेंगे।'' विवाद शुरू हो गया। उधर द्वार पर काम चलता रहा। एक दिन राजा ने इसे गिराने का फैसला ले लिया। टीलों को खबर लगी। रातों-रात टीलों ने प्रवेश द्वार की सबसे ऊँची मंजिल में मन्दिर बनवा दिया। महारावल ने अपना निर्णय बदला। तब से पूरा शहर इसी सुन्दर पोल से तालाब में प्रवेश करता है और बड़े जतन से इसे टीलों के नाम से ही याद रखते हैं।

टीलों की पोल के ठीक सामने तालाब की दूसरी तरफ परकोटेनुमा एक गोल बुर्ज है। तालाबों के बाहर तो अमराई, बगीचे आदि होते ही हैं पर इस बुर्ज में तालाब के भीतर बगीची बनी है, जिसमें लोग गोठ करने, यानी आनन्द-मंगल मनाने आते रहते थे। इसी के साथ पूरब में एक और बड़ा गोल परकोटा है। इसमें तालाब की रक्षा करने वाली फौज की टुकड़ी रहती थी। देशी-विदेशी शत्रुओं से घिरा राज पूरी आबादी को पानी देने वाले इस तालाब की सुरक्षा का भी पक्का प्रबन्ध रखता था।

मरुभूमि में पानी कितना भी कम

बरसता हो, घड़सीसर का आगौर अपने मूलरूप में इतना बड़ा था कि वह वहाँ की एक-एक बूँद को समेट कर तालाब को लबालब भर देता था। तब तालाब की रखवाली फौज की टुकड़ी के हाथ से निकल कर नेष्टा के हाथ में आ जाती। नेष्टा चलता और इतने विशाल तालाब को तोड़ सकने वाले अतिरिक्त पानी को बाहर बहाने लगता। लेकिन यह 'बहाना' भी बहुत विचित्र था। जो लोग एक-एक बूँद एकत्र कर घड़सीसर भरना जानते थे, वे उसके अतिरिक्त पानी को पानी नहीं जलराशि मानते थे। नेष्टा तब भी नहीं रुकता तो इस तालाब का नेष्टा भी चलने लगता। फिर उससे भी एक और तालाब भर जाता। यह सिलसिला, आसानी से भरोसा न होगा, पूरे नौ तालाबों तक चलता रहता। नौताल, गोविंदसर, जोशीसर, गुलाबसर, भाटियासर, सूदासर, मोहतासर, रत्नसर, और फिर किसनघाट। यहाँ तक पहुँचने पर भी पानी बचता तो किसनघाट के बाद उसे कई बेरियों में, यानी छोटे छोटे कुएंनुमा कुंडों में भरकर रख लिया जाता। पानी की एक एक बूँद जैसे शब्द और वाक्य घड़सीसर से किसनघाट तक के सात मील लंबे क्षेत्र में अपना ठीक अर्थ पाते थे।

लेकिन आज जिनके हाथ में जैसलमेर है, राज है, वे घड़सीसर का अर्थ ही भूल चले हैं तो उसके नेष्टा से जुड़े नौ तालाबों की याद उन्हें भला कैसे रहेगी! घड़सीसर के आगौर में वायुसेना का हवाई अड्डा बन गया है। इसलिए आगौर के इस हिस्से का पानी अब तालाब की ओर न जाकर कहीं और बह जाता है। नेष्टा और उसके रास्ते में पड़ने वाले नौ तालाबों के आसपास भील बेतरतीब बढ़ते शहर के मकान, नई गृह निर्माण समितियां, और ता और पानी का ही नया काम करने वाला इंदिरा नहर प्राधिकरण का दफ्तर, उसमें काम करने वालों की कालोनी बन गई है। घाट, पठसाल, पाठशालाएं, रसोई, बरामदे, मंदिर ठीक सार-संभाल के अभाव में धीरे धीरे टूट चले हैं। आज शहर ल्हास का वह खेल भी नहीं खेलता, जिसमें राजा-प्रजा सब मिलकर घड़सीसर की सफाई करते थे, साद निकालते थे। तालाब के किनारे रथापित पथर का जलस्तंभ भी थोड़ा-सा हिलकर एक तरफ झुक गया है। रखवाली करने वाली फौज की टुकड़ी के बुर्ज के पथर भी ढह गए हैं।

फिर भी 668 बरस पुराना घड़सीसर मरा नहीं है। बनाने वालों ने उसे समया के थपेड़े सह जाने लायक मजबूती दी थी। रेत की आंधियों के बीच अपने तालाबों की उम्दा सार



लेकिन आज जिनके हाथ में राज है, वे घड़सीसर का अर्थ ही भूल चले हैं तो उसके नेष्टा से जुड़े नौ तालाबों की याद उन्हें भला कैसे रहेगी! घड़सीसर के आगौर में वायुसेना का हवाई अड्डा बन गया है। इसलिए आगौर के इस हिस्से का पानी अब तालाब की ओर न जाकर कहीं और बह जाता है।

-संभाल की परंपरा डालने वालों को शायद इसका अंदाज नहीं था कि कभी उपेक्षा की आंधी भी चलेगी। लेकिन इस आंधी को भी घड़सीसर और उसे आज भी चाहने वाले लोग बहुत धीरज के साथ सह रहे हैं। तालाब पर पहरा देने वाली फौजी टुकड़ी आज भले ही नहीं हो, लोगों के मन का पहरा आज भी है। पहली किरण के साथ मंदिरों की घंटियां बजती हैं। दिन भर लोग घाटों पर आते -जाते हैं। कुछ लोग यहाँ घंटों मौन बैठे-बैठे घड़सीसर को निहारते रहते हैं, तो कुछ गीत गाते और रावण हत्था, एक तरह की सारंगी बजाते हुए मिलते हैं।

पनिहारिनें आज भी घाटों पर आती हैं। पानी ऊंटगाड़ियों भी जाता है और दिन में कई बार ऐसी टैंकर गाड़ियां भी यहाँ देखने को मिल जानी हैं, जिनमें घड़सीसर का पानी भरने के लिए डीजल पंप तक लगा रहता है। घड़सीसर आज भी पानी दे रहा है और इसीलिए सूरज आज भी उगते और डूबते समय घड़सीसर में मन भर सोना उंडेल जाता है। घड़सीसर मानक बन चुका था। उसके बाद किसी और तालाब को बनाना कहुत कठिन रहा होगा। पर जैसलमेर में हर सौ - पचास बरस के अंतर पर तालाब बनते रहे-एक से एक, मानक के साथ मोती की तरह गुंथे हुए।

घड़सीसर से कोई 175 बरस बाद बना था जैतसर। यह था तो बंधनुमा तालाब ही पर अपने बड़े बगीचे के कारण बाद में बस इसे 'बड़ा बाग' की तरह ही याद रखा गया। इस

पथर के बांध ने जैसलमेर के उत्तर की तरफ खड़ी पहाड़ियों से आने वाला सारा पानी रोक लिया है। एक तरफ जैतसर है और दूसरी तरफ उसी पानी से सिंचित बड़ा बाग। दोनों का विभाजन करती है बांध की दीवार। लेकिन यह दीवार नहीं, अच्छी खासी चौड़ी सड़क लगती है जो घाटी पार कर सामने की पहाड़ी तक जाती है। दीवार के नीचे बनी सिंचाई नाली का नाम है राम नाल। राम नाल नहर, बांध की तरफ सीढ़ीनुमा है। जैतसर में पानी का स्तर ज्यादा हो या कम, नहर का सीढ़ीनुमा ढांचा पानी को बड़े बाग की तरफ उतारता रहता है। बड़ा बाग में पहुँचने पर राम नाल राम नाम की ररह कण कण में बंट जानी है। नहर के पहले छोर पर एक कुआं भी है। पानी सूख जाए, नहर बंद हो जाए ता रिसन से भरे कुएं का उपयोग होने लगता है। उधर बांध के उस पार आगर का पानी सूखते ही उसमें गेहूं बो दिया जाता है। तब बांध की दीवार के दोनों ओर बस हरा ही हरा दिखता है।

हरा बाग सचमुच बहुत बड़ा है। विशाल और ऊंची अमराई और उसके साथ साथ साथ तरह तरह के पेड़ पौधे। अधिक वर्षा वाले क्षेत्रों में, वहाँ भी प्रायः नदी के किनारे मिलने वाला अर्जुन का पेड़ भी बड़ा बाग में मिल जाएगा। बड़ा बाग में सूरज की किरणें पेड़ों की पत्तियों में अटकी रहती हैं, हवा चले, पत्तियां हिलें तो मौका पाकर किरणें नीचे छन - छन कर टपकती रहती हैं। बांध के उस पार पहाड़ियों पर राजघराने का शमशान है। यहाँ दिवंगतों की

जैसलमेर मरुभूमि का एक ऐसा राज रहा है, जिसका व्यापारी-दुनिया में डंका बजता था। फिर मंदी का दौर भी आया पर जैसलमेर और उसके आस-पास तालाब बनाने का काम मंदा नहीं पड़ा। गजरूप सागर, मूल सागर, गंगा सागर, गुलाब तालाब और ईसरलालजी का तालाब-एक के बाद एक तालाब बनते चले गए। यह कड़ी अंग्रेजों के आने तक दूटी नहीं थी। इस कड़ी की मजबूती सिर्फ राजाओं, रावलों, महारावलों पर नहीं छोड़ी गई थी। समाज के वे अंग भी, जो आज की परिभाषा में आर्थिक रूप से कमजोर माने जाते हैं, तालाबों की कड़ी को मजबूत बनाए रखते थे।

स्मृति में असंख्य सुन्दर छतरियां बनी हैं।

अमर सागर घड़सीसर से 325 साल बाद बना। किसी और दिशा में बरसने वाले पानी को रोकना मुख्य कारण रहा ही होगा लेकिन अमर सागर बनाने वाले संभवतः यह भी जताना चाहते थे कि उपयोगी और सुन्दर तालाबों को बनाते रहने की इच्छा अमर है। पथर के टुकड़ों को जोड़-जोड़ कर कितना बेजोड़ तालाब बन सकता है-अमर सागर इसका अद्भुत उदाहरण है। तालाब की चौड़ाई की एक भुजा सीधी खड़ी ऊंची दीवार से बनाई गई है। दीवार पर जुड़ी सुन्दर सीढ़ीयां झरोखों और बुर्ज में से होती हुई नीचे तालाब में उतरती हैं। इसी दीवार के बड़े सपाट भाग में अलग-अलग ऊंचाई पर पथर के हाथी घोड़े बने हैं। ये सुन्दर सजी-धजी मूर्तियां तालाब का जलस्तर बताती हैं। अमर सागर का आगौर इतना बड़ा नहीं है कि वहां से साल भर का पानी जमा हो जाए। गर्मी आते आते तालाब सूखने लगता। इसका अर्थ था कि जैसलमेर के लोग इतने सुन्दर तालाब को उस मौसम में भूल जाएं, जिसमें पानी सबसे ज्यादा जरूरत रहती!

जैसलमेर के शिल्पियों ने यहां कुछ ऐसे काम किए, जिनसे शिल्पशास्त्र में कुछ नए पने जुड़ सकते हैं! यहां तालाब के तल में सात सुन्दर बेरियां बनाई गईं। बेरी यानी एक तरह की बावड़ी यह पगबाव भी कहलाती है पगबाव शब्द पगवाह से बना है। वाह या बाय या बावड़ी। पगबाव यानी जिसमें पानी तक पग, पग, पैदल ही पहुंचा जा सके। तालाब का पानी सूख जाता है, इसी साफ़ छने पानी से बेरियां भरी रहती हैं। बेरियां भी ऐसी बनी हैं कि ग्रीष्म में अपना जल

खो बैठा अमर सागर अपनी सुन्दरता नहीं खो देता। सभी बेरियों पर पथर के सुन्दर चबूतरे, स्तम्भ, छतरियाँ और नीचे उतरने के लिए कलात्मक सीढ़ियां। गर्मी में, बैसाब में भी मेला भरता है और बरसात में, भादों में भी। सूखे अमर सागर में ये छतरीदार बेरियां किसी महल के टुकड़े सी लगती हैं और जब यह भर जाता है तो लगता है कि तालाब में छतरीदार बड़ी-बड़ी नावें तैर रही हैं।

जैसलमेर मरुभूमि का एक ऐसा राज रहा है, जिसका व्यापारी-दुनिया में डंका बजता था। फिर मंदी का दौर भी आया पर जैसलमेर और उसके आस-पास तालाब बनाने का काम मंदा नहीं पड़ा। गजरूप सागर, मूल सागर, गंगा सागर, गुलाब तालाब और ईसरलालजी का तालाब-एक के बाद एक तालाब बनते चले गए। यह कड़ी अंग्रेजों के आने तक दूटी नहीं थी। इस कड़ी की मजबूती सिर्फ राजाओं, रावलों, महारावलों पर नहीं छोड़ी गई थी। समाज के वे अंग भी, जो आज की परिभाषा में आर्थिक रूप से कमजोर माने जाते हैं, तालाबों की कड़ी को मजबूत बनाए रखते थे।

मेघ ढोर चराया करता था। यह किस्सा 500 बरस पहले का है। पशुओं के साथ मेघ भोर सुबह निकल जाता। कोसों तक फैला सपाट रेगिस्तान। मेघ दिन भर का पानी अपने साथ एक कुपड़ी, मिट्टी की चपटी सुराही में ले जाता। शाम वापस लौटता। एक दिन कुपड़ी में थोड़ा-सा पानी बच गया। मेघ को न जाने क्या सूझा, उसने एक छोटा-सा गड्ढा किया, उसमें कुपड़ी का पानी डाला और आक के पत्तों से गड्ढे को अच्छी तरह ढंक दिया। चराई का काम। आज यहाँ, कल कहीं और और। मेघ दो दिन तक उस जगह पर नहीं जा सका। वहाँ वह तीसरे दिन पहुँच पाया। उत्सुक हाथों ने आक के पते धीरे से हटाए। गड्ढे में पानी तो नहीं था पर ठण्डी हवा आई। मेघ के मुँह से शब्द निकला-‘भाप’। मेघ ने सोचा कि यहाँ इतनी गर्मी में थोड़े से पानी की नमी बची रह सकती है तो फिर यहां तालाब भी बन सकता है।

मेघ ने अकेले ही तालाब बनाना शुरू किया। अब वह रोज अपने साथ कुदाल-तगारी भी लाता। दिन भर अकेले मिट्टी खोदता और पाल पर डालता। गायें भी वर्षी आस-पास चरती रहती हैं। भीम जैसी शक्ति नहीं थी, लेकिन भीम

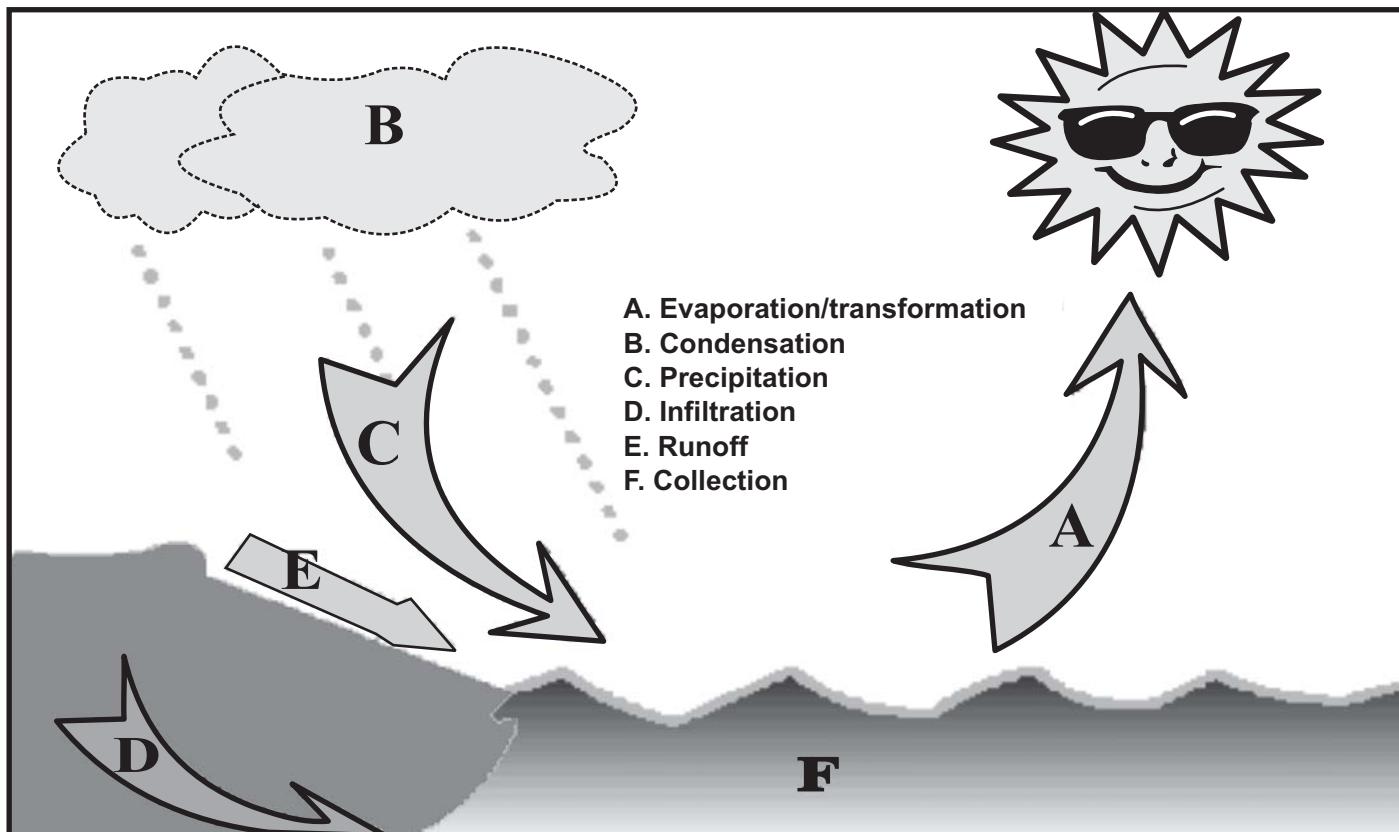
की शक्ति जैसा संलत्य था मेघा के पास। दो वर्ष तक वह अकेले ही लगा रहा। सपाट रेगिस्तान में पाल का विशाल धेरा अब दूर से ही दिखने लगा था। पाल की खबर गांव को भी लगी। अब रोज सुबह गांव से बच्चे और दूसरे लोग भी मेघा के साथ आने लगे। सब मिलकर काम करते। 12 साल हो गए थे, अब भी विशाल तालाब पर काम चल रहा था। लेकिन मेघा की उमर पूरी हो गई। पत्नी सती नहीं हुई। अब तालाब पर मेघा के बदले वह काम करने आती। 6 महीने में तालाब पूरा हुआ।

भाप के कारण बनना शुरू हुआ था, इसलिए इस जगह का नाम भी भाप पड़ा जो बाद में बिंगड़कर बाप हो गया। चरवाहे मेघा को, समाज ने मेघोजी की तरह याद रखा और तालाब की पाल पर ही उनकी सुन्दर छतरी और उनकी पत्नी की स्मृति में वर्ही एक देवली बनाई गई। बाप बीकानेर-जैसलमेर के रास्ते में पड़ने वाला छोटा-सा करबा है। चाय और कचौरी की 5-7 दुकानों वाला बस अड़ा है। बसों से तिगुनी ऊँची पाल अड़े के बगल में खड़ी है। मई-जून में पाल के इस तरफ लू चलती है, उस तरफ मेघोजी के तालाब में लहरें उठती हैं। बरसात के दिनों में तो तालाब में लाखेटा (द्वीप) ‘लग’ जाता है। तब पानी 4 मील में फैल जाता है।

मेघ और मेघराज भले ही यहाँ कम आते हों, लेकिन मरुभूमि में मेघोजी जैसे लोगों की कमी नहीं रही। पानी के मामले में इतना योग्य बन चुका समाज अपनी योग्यता को, कौशल को, अपना बताकर घमंड नहीं करता वह विनम्र भाव से इसका पूरा श्रेय भगवान को सौंप कर सिर झुका लेता है। कहते हैं कि महाभारत युद्ध समाप्त हो जाने के बाद श्रीकृष्ण कुरुक्षेत्र से अर्जुन को साथ लेकर द्वारिका जा रहे थे। उनका रथ मरुप्रदेश पार कर रहा था। आज के जैसलमेर के पास त्रिकूट पर्वत पर उन्हें उत्तुंग ऋषि तपस्या करते हुए मिले। श्रीकृष्ण ने उन्हें प्रणाम किया और फिर वर मांगने को कहा। उत्तुंग का अर्थ है ऊँचा। सचमुच ऋषि ऊँचे थे। उन्होंने अपने लिए कुछ नहीं मांगा। प्रभु से प्रार्थना की कि यदि मेरे कुछ पुण्य हैं तो भगवान वर दें कि इसक्षेत्र में कभी जल का अभाव न रहे। मरुभूमि के समाज ने इस वरदान को एक आदेश की तरह लिया और अपने कौशल से मृगतृष्णा को झुठला दिया। ■

(लेखक सुप्रसिद्ध गाँधीवादी चिंतक हैं।)

Techniques of Rain Water Harvesting



■ DEVI SINGH



DEVI SINGH

In a progressive society it is natural that demands of water remain on the rise. In this context the issues are varied and complex in our country, because in India there are remarkable variation in the availability of water on account of the regional rainfall and geography. Alongwith, the increasing population and urbanization are having telling effect on the availability and quality of water.

Rain water harvesting is the technique of collection and storage of rain water at surface or in sub-surface aquifers, before it is lost as surface runoff. The augmented resource can be harvested in the time of need. Artificial recharge to ground water is a process by which the ground water reservoir is augmented at rate exceeding that under natural conditions of replenishment.

NEED

- ◆ To overcome the inadequacy of waters to meet our demands.
- ◆ To arrest decline in ground water levels.
- ◆ To enhance availability of ground water at specific place and time and utilize rain water for sustainable development.

- ◆ To increase infiltration of rain water in the subsoil which has decreased drastically in urban areas due to paving of open area.
- ◆ To improve ground water quality by dilution.
- ◆ To increase agriculture production.
- ◆ To improve ecology of the area by increase in vegetation cover, etc.

ADVANTAGES

- ◆ Cost of recharge to sub-surface reservoir is lower than surface reservoirs.
- ◆ The aquifer serves as distribution system also.
- ◆ No land is wasted for storage purpose and no population displacement is involved.
- ◆ Ground water is not directly

- exposed to evaporation and pollution.
- ♦ Storing water underground is environment friendly.
- ♦ It increases the productivity of aquifer.
- ♦ It reduces flood hazards.
- ♦ Effects rise in ground water levels.
- ♦ Mitigates the effects of drought.
- ♦ Reduces soil erosion.

DESIGN CONSIDERATIONS:

The important aspects to be looked into for designing a rainwater harvesting system to augment ground water resources are:-

- ♦ Hydrogeology of the area including nature and extent of aquifer, soil cover, topography, depth to water level and chemical quality of ground water.
- ♦ The availability of source water, one of the prime requisite for ground water recharge, basically assessed in terms of non-committed surplus monsoon runoff.
- ♦ Area contributing run off like area available, land use pattern, industrial, residential, green belt, paved areas, roof top area etc.
- ♦ Hydrometeorological characters like rainfall duration, general pattern and intensity of rainfall.

POTENTIAL AREAS

- ♦ Where ground water levels are declining on regular basis.
- ♦ Where substantial amount of aquifer has been de-saturated.
- ♦ Where availability of ground water is inadequate in lean months.
- ♦ Where due to rapid urbanization, infiltration of rain water into subsoil has decreased drastically and recharging of ground water has diminished.

METHODS & TECHNIQUES

The methods of ground water recharge mainly are:

- ♦ Urban Areas
 - Roof Top Rain Water /Storm run off harvesting through
 - i) Recharge Pit
 - ii) Recharge Trench
 - iii) Tubewell
 - iv) Recharge Well
- ♦ Rural Areas
 - Rain Water Harvesting through
 - a) Gully Plug
 - b) Contour Bund
 - c) Gabion Structure
 - d) Percolation tank
 - e) Check Dam/ Cement Plug/ Nala Bund
 - f) Recharge shaft
 - g) Dugwell Recharge
 - h) Ground Water Dams/ Sub-surface Dyke

URBAN AREAS

In urban areas, rain water available from roof tops of buildings, paved and unpaved areas goes waste. This water can be recharged to aquifer and can be utilized gainfully at the time of need. The rain water harvesting system needs to be designed in a way that it does not occupy large space for collection and recharge system. A few techniques of roof top rain water harvesting in urban areas are described below.

(i) ROOF TOP RWH THROUGH RECHARGE PIT

- ♦ In alluvial areas where permeable rocks are exposed on the land surface or at very shallow depth, roof top rain water harvesting can be done through recharge pits.
- ♦ The technique is suitable for buildings having a roof area of 100 sq.m. and are constructed for recharging the shallow aquifers.
- ♦ Recharge Pits may be of any shape and size and are generally constructed 1 to 2 m. wide and 2 to 3 . deep which are back filled with boulders (5-20 cm), gravels (5-10mm) and coarse sand (1.5- 2mm) in graded form. Boulders at the bottom, gravels in between and coarse sand at the top so that the silt

content that will come with runoff will be deposited on the top of the coarse sand layer and can easily be removed. For smaller roof area, pit may be filled with broken bricks/ cobbles.

- ♦ A mesh should be provided at the roof so that leaves or any other solid waste / debris is prevented from entering the pit and a desilting /collection chamber may also be provided at the ground to arrest the flow of finer particles to the recharge pit.
- ♦ The top layer of sand should be cleaned periodically to maintain the recharge rate.
- ♦ By-pass arrangement be provided before the collection chamber to reject the first showers.

(ii) ROOF TOP RWH THROUGH RECHARGE TRENCH

- ♦ Recharge trenches are suitable for buildings having roof area of 200- 300 sq. m. and where permeable strata is available at shallow depths.
- ♦ Trench may be 0.5 to 1 m wide, 1 to 1.5m. deep and 10 to 20 m. long depending upon availability of water to be recharge.
- ♦ These are back filled with boulders (5-20cm), gravel (5-10 mm) and coarse sand (1.5-2 mm) in graded form – boulders at the bottom, gravel in between and coarse sand at the top so that the silt content that will come with runoff will be coarse sand at the top of the sand layer and can easily be removed.
- ♦ A mesh should be provided at the roof so that leaves or any other solid waste/debris is prevented from entering the trenches and a desilting/collection chamber may also be provided on ground to arrest the flow of finer particles to the trench.
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cleaned periodically to maintain the recharge rate.

(iii) ROOF TOP RWH THROUGH EXISTING TUBE WELLS

→ In areas where the shallow aquifers have dried up and existing tubewells are tapping deeper aquifer, roof to rain water harvesting through existing tubewell can be adopted to recharge the deeper aquifers.

→ PVC pipes of 10 cm dia are connected to roof drains to collect rainwater. The first roof runoff is let off through the bottom of drainpipe. After closing the bottom pipe, the rainwater of subsequent rain showers is taken through a T to an online PVC filter. The filter may be provided before water enters the tubewells. The filter is 1 –1.2 m. in length and is made up of PVC pipe. Its diameter should vary depending on the area of roof, 15 cm if roof area is less than 150 sq m and 20 cm if the roof area is more. The filter is provided with a reducer of 6.25 cm on both the sides. Filter is divided into three chambers by PVC screens so that filter material is not mixed up. The first chamber is filled up with gravel (6-10mm), middle chamber with pebbles (12-20 mm) and last chamber with bigger pebbles (20-40 mm).

→ If the roof area is more, a filter pit may be provided. Rainwater from roofs is taken to collection/desilting chambers located on ground. These collection chambers are interconnected as well as connected to the filter pit through pipes having a slope of 1:15. The filter pit may vary in shape and size depending upon available runoff and are back-filled with graded material, boulder at the bottom, gravel in the middle and sand at the top with varying thickness (0.30-0.50m) and may be separated by screen. The pit is divided into two

chambers, filter material in one chamber and other chamber is kept empty to accommodate excess filtered water and to monitor the quality of filtered water. A connecting pipe with recharge well is provided at the bottom of the pit for recharging of filtered water through well.

(iv) ROOF TOP RWH THROUGH TRENCH WITH RECHARGE WELL

→ In areas where the surface soil is impervious and large quantities of roof water or surface runoff is available within a very short period of heavy rainfall, the use of trench/ pits is made to store the water in a filter media and subsequently recharge to ground water through specially constructed recharge wells.

→ This technique is ideally suited for area where permeable horizon is within 3m below ground level.

→ Recharge well of 100-300 diameter is constructed to a depth of at least 3 to 5 m below the water level. Based on the lithology of the area well assembly is designed with slotted pipe against the shallow and deeper aquifer.

→ A lateral trench of 1.5 to 3m width and 10 to 30 m length, depending upon the availability of water is constructed with the recharge well in the centre.

→ The number of recharge wells in the trench can be decided on the basis of water availability and local vertical permeability of the rocks.

→ The trench is backfilled with boulders, gravels and coarse sand to act as a filter media for the recharge wells.

→ If the aquifer is available at greater depth say more than 20 meters, a shallow shaft of 2 to 5 m diameter and 3-5 meters deep may be constructed depending upon availability of runoff. Inside the shaft a recharge well of 100-300 mm dia is constructed for

recharging the available water to the deeper aquifers. At the bottom of the shaft a filter media is provided to avoid choking of recharge well.

RURAL AREAS

In rural areas, rain water harvesting is taken up considering watershed as a unit. Surface spreading techniques are common since space for such systems is available in plenty and quantity of recharged water is also large. Following techniques may be adopted to save water going waste through slopes, rivers, rivulets and nallas.

(i) RWH THROUGH GULLY PLUG

→ Gully Plugs are built using local stones, clay and bushes across small gullies and streams running down the hill slopes carrying drainage to tiny catchments during rainy season.

→ Gully Plugs help in conservation of soil and moisture.

→ The sites for gully plugs may be chosen whenever there is a local break in slope to permit accumulation of adequate water behind the bunds.

(ii) RWH THROUGH CONTOUR BUND

→ Contour Bunds are effective methods to conserve soil moisture in watershed for long duration.

→ These are suitable in low rain fall areas where monsoon run off can be impounded by constructing bunds on the sloping ground all along the contour of equal elevation.

→ Flowing water is intercepted before it attains the erosive velocity by keeping suitable spacing between bunds.

→ Spacing between two contour bunds depends on the slope the area as the permeability of the soil.

Lesser the permeability of soil, the close should be spacing of bunds.
→ Contour bunding is suitable on lands with moderate slopes without involving terracing.

(iii) RWH THROUGH GABION STRUCTURE

→ This is a kind of check dam commonly constructed across small streams to conserve stream flows with practically no submergence beyond stream course.
→ A small bund across the stream is made by putting locally available boulders in a mesh of steel wires and anchored to the stream banks.
→ The height of such structures is around 0.5 m and is normally used in the streams with width of less than 10 m.
→ The excess water over flows this structure storing some water to serve as source of recharge. The silt content of stream water in due course is deposited in the interstices of the boulders in due course and with growth of vegetation, the bund becomes quite impermeable and helps in retaining surface water run off for sufficient time after rains to recharge the ground water body.

(iv) RWH THROUGH PERCOLATION TANK

→ Percolation tank is an artificially created surface water body, submerging in its reservoir a highly permeable land so that surface runoff is made to percolate and recharge the ground water storage.
→ Percolation tank should be constructed preferably on second to third order streams, located on highly fractured and weathered rocks, which have lateral continuity downstream.
→ The recharge area down stream should have sufficient number of wells and cultivable land to benefit from the augmented ground water.
→ The size of percolation tank should

be governed by percolation capacity of strata in the tank bed. Normally percolation tanks are designed for storage capacity of 0.1 to 0.5 MCM. It is necessary to design the tank to provide a ponded water column generally between 3 & 4.5 m.

→ The percolation tanks are mostly earthen dams with masonry structure only for spillway. The purpose of the percolation tanks is to recharge the ground water storage and hence seepage below the seat of the bed is permissible. For dams upto 4.5 m height, cut off inches are not necessary and keying and benching between the dam seat and the natural ground is sufficient.

(v) RWH THROUGH CHECK DAMS / CEMENT PLUGS / NALA BUNDLS

→ Check dams are constructed across small streams having gentle slope. The site selected should have sufficient thickness of permeable bed or weathered formation to facilitate recharge of stored water within short span of time.

→ The water stored in these structures is mostly confined to stream course and the height is normally less than 2 m and excess water is allowed to flow over the wall. In order to avoid scouring from excess run off, water cushions are provided at downstream side.

→ To harness the maximum run off in the stream, series of such check dams can be constructed to have recharge on regional scale.

→ Clay filled cement bags arranged as a wall are also being successfully used as a barrier across small nalas. At places, shallow trench is excavated across the nala and asbestos sheets are put on two sides. The space between the rows of asbestos sheets across the nala is backfilled with clay. Thus a low cost check dam is created. On the upstream side clay filled cement bags can be stacked in a slope to provide stability to the structure.

(vi) RWH THROUGH RECHARGE SHAFT

→ This is the most efficient and cost effective technique to recharge unconfined aquifer overlain by poorly permeable strata.
→ Recharge shaft may be dug manually if the strata is of non-caving nature. The diameter of shaft is normally more than 2 m.
→ The shaft should end in more permeable strata below the top impermeable strata. It may not touch water table.
→ The unlined shaft should be backfilled, initially with boulders/ cobbles followed by gravel and coarse sand.
→ In case of lined shaft the recharge water may be fed through a smaller conductor pipe reaching up to the filter pack.
→ These recharge structures are very useful for village ponds where shallow clay layer impedes the infiltration of water to the aquifer.
→ It is seen that in rainy season village tanks are fully filled up but water from these tanks does not percolate down due to siltation and tubewell and dugwells located nearby remains dried up. The water from village tanks get evaporated and is not available for the beneficial use.
→ By constructing recharge shaft in tanks, surplus water can be recharged to ground water. Recharge shafts of 0.5 to 3 m. diameter and 10 to 15 m. deep are constructed depending upon availability of quantum of water. The top of shaft is kept above the tank bed level preferably at half of full supply level. These are back filled with boulders, gravels and coarse sand.
→ In upper portion of 1 or 2 m depth, the brick masonry work is carried out for the stability of the structure.
→ Through this technique all the accumulated water in village tank above 50% full supply level would be recharged to ground water. Sufficient water will continue to remain in tank for domestic use.

after recharge. Abandoned Dug Well Abandoned Dug Well fitted with Rain Water Harvesting Mechanism

(vii) RWH THROUGH DUGWELL RECHARGE

- Existing and abandoned dug wells may be utilized as recharge structure after cleaning and desilting the same.
- The recharge water is guided through a pipe from desilting chamber to the bottom of well or below the water level to avoid scouring of bottom and entrapment of air bubbles in the aquifer.
- Recharge water should be silt free and for removing the silt contents, the runoff water should pass either through a desilting chamber or filter chamber.
- Periodic chlorination should be done for controlling the bacteriological contaminations.

(viii) SUB-SURFACE DYKES

- Sub surface dyke or under-ground dam is a subsurface barrier across stream which retards the base flow and stores water upstream below ground surface. By doing so, the water levels in upstream part of ground water dam rises saturating otherwise dry part of aquifer.
- The site where sub-surface dyke is proposed should have shallow impervious layer with wide valley and narrow outlet.
- After selection of suitable site, a trench of 1-2 m wide is dug across the breadth of stream down to impermeable bed. The trench may be filled with clay or brick/ concrete wall upto 0.5m. below the ground level.
- For ensuring total imperviousness, PVC sheets of 3000 PSI tearing strength at 400 to 600 gauge or low-density polythene film of 200 gauges can also be used to cover the cut out dyke faces.

→ Since the water is stored within the aquifer, submergence of land can be avoided and land above the reservoir can be utilized even after the construction of the dam. No evaporation loss from the reservoir and nosiltation in the reservoir takes place. The potential disaster like collapse of the dams can also be avoided of the total water on earth only 3% constitutes freshwater. Rest is saline water in the oceans.

DISTRIBUTION OF FRESH WATER ON EARTH

- ◆ 11% of the total freshwater on earth is groundwater available upto a depth of 800m which can be extracted for use.
- ◆ Mindless extraction and over exploitation of very small quantity of this precious nature resource has caused a rapid depletion and deterioration in its quantity and quality both.

*(Author is retd. additional chief engineer, PHED, Rajasthan

Rainwater harvesting

A Complete Solution for India

■ S. Vishwanath

Water availability per capita has been on the decline in India. Two reasons have been the increasing demand for water and the increasing population. The quantum of water available to the country being fixed the increasing demand reduces per capita water availability. Agriculture continues to be the single largest consumer of water however industrial demand for water shows the fastest growth. Especially South India and in particular Karnataka is a drought prone region. The state enjoys the dubious distinction of having the second largest area prone to drought next only to Rajasthan.

Water scarcity is however a world wide issue and many steps are being taken to manage it from policy and

project levels but increasingly it is being recognized that people from various sectors have to become partners in the solution process and not remain simply as institutional beneficiaries.

India is blessed with adequate rainfall as a whole, yet there are large swathes of dry, drought prone area. In many other places the quality of groundwater is not good. In such places rainwater harvesting can provide lifeline water for survival and more.

Solutions for water management: At a broader level Economic pricing of water, legal framework for its sustainable management, information and training for its adequate management are all solution. At a smaller micro level, efficient use of

water is one solution as is water reuse and recycling. Rainwater harvesting is emerging as one more component in the basket of solutions.

Rainwater harvesting:

The collection and storage of rain water for later productive use is defined as rainwater harvesting.

With severe drought being experienced in several parts of the world, rainwater harvesting an ancient technique is fast reemerging on the development sector front as a potential weapon for 'water security' of people, villages and industries.

world, rainwater harvesting an ancient technique is fast reemerging on the development sector front as a potential weapon for 'water security' of people, villages and industries.

Components of rainwater harvesting:

Any rainwater harvesting system has three components

- (a) Catchment
- (b) Conveyance
- (c) Storage

Rainwater harvesting is further categorized based on the catchment for the rainwater as **rooftop** rainwater harvesting, rainwater harvesting from paved and unpaved area called **storm water** harvesting rainwater harvesting from water channels or streams called **flood water** harvesting

Catchment:

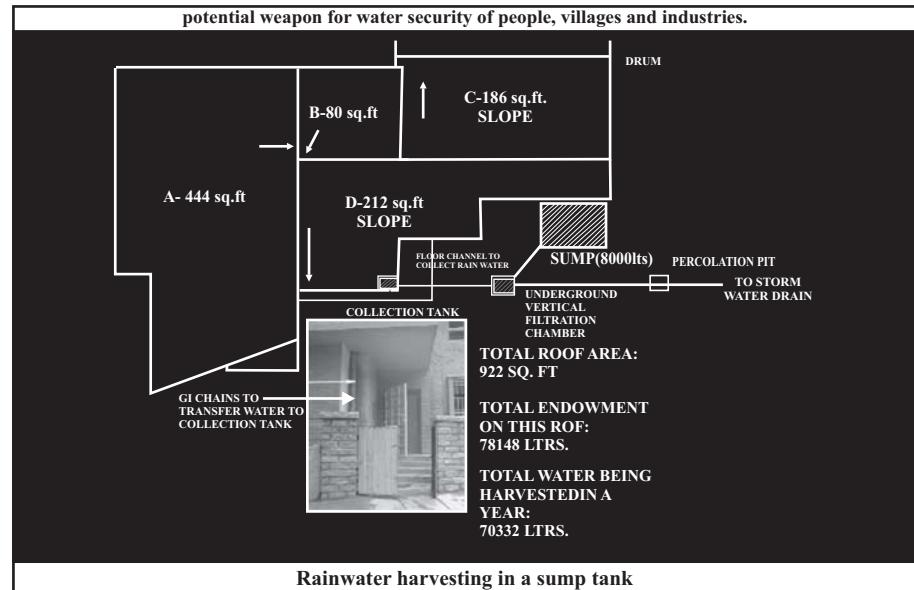
Any surface can act as the catchment for rainwater harvesting. rooftops are favoured because of the large coefficient of run-off generated from them and the relatively less likelihood of their contamination. Paved areas, footpaths and roads are also good rainwater runoff generators and with adequate catchment management strategies can provide good quantity and adequate quality of runoff water for use. Unpaved areas also generate runoff during heavy storms and can be modified to act as rainwater catchment.

Conveyance:

Conveyance systems can be the catchment surface itself acting as a sheet runoff. For rooftops rainwater gutters and rainwater down pipes are conveyance systems, which need to be designed appropriately so as to manage the severest intensity of rain as well as not to lose any water during the conveyance process. Storm water drains, French drains with pebbles are also conveyance systems.

Storage:

From the simplest ground level tank, to underground sumps, surface lined ponds and large lakes storage options are many depending on the context of the rainwater harvesting



design. In many a case the soil profile may also permit artificial recharge of rainwater to open wells and borewells where water can be stored to be retrieved later for productive use.

Rainwater harvesting urban areas:

A simple rain barrel connected to the down pipes bringing rain down from the roof is a good way to begin. Depending on the distribution of rainfall at a place, substantial amounts of rainwater can be harvested. In Bangalore for example, if a 500 litre rain barrel is connected to a 50 square metre roof, more than 23,000 litres of rain can be harvested annually. A slight increase in storage capacity of say 6000 litres connected to a 100 square metre roof area can harvest between 70,000 to 80,000 litres annually. A recharge well is another interesting way of harvesting rainwater. Typically such wells are about 1 metre in diameter and can go to be 6 metres deep or even deeper.

Rainwater from rooftops and even from land surface can be led into these recharge wells. They will revitalize the groundwater table and in many cases aquifers have been rejuvenated and groundwater has become accessible for use.

Rainwater harvesting in rural areas:

Traditionally water harvesting was done in 'tanks', manmade lakes and 'kalyani' or step well in rural areas. In the

modern context, it is necessary to revive the ancient culture of maintaining these beautiful rain harvesting structures and make them functional.

Rooftop rainwater harvesting has also become necessary in villages suffering for lack of water. These structures provide clean fluoride and arsenic free water at the door step. In rural areas farm ponds are good methods of harvesting rainwater. They can either be used as collection structures or as recharge structures depending on the nature of the soil and the condition of infiltration and percolation at a place. Poly houses too can harvest rainwater and if used through a drip irrigation mechanism much water requirement of the poly house can come from rain water

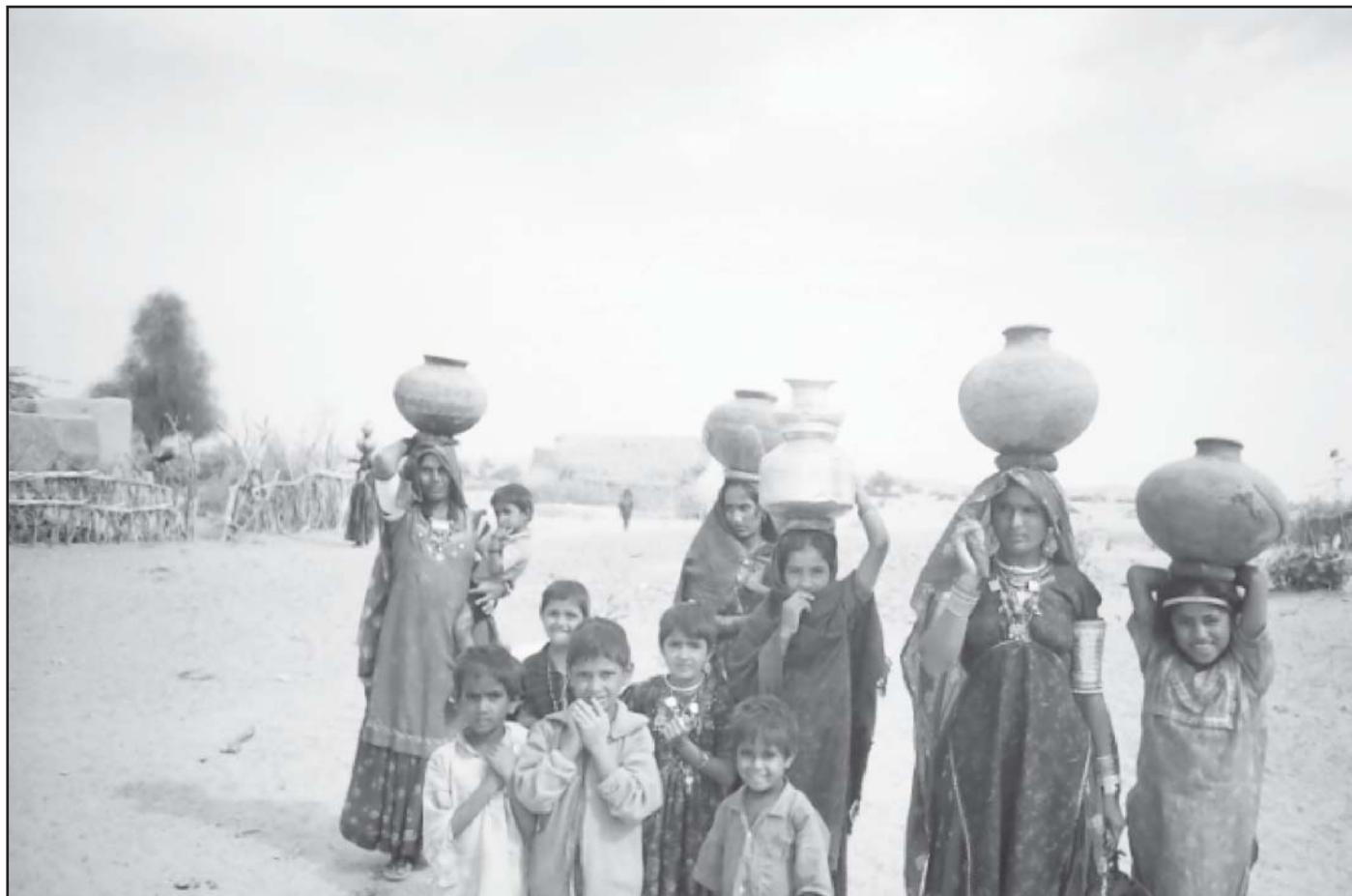
Potential for rainwater harvesting:

One acre of land in Bangalore for example, with about 900 mm of rain receives **nearly 36 lakh litres of water** as endowment. A small 100 square metre of roof area would receive **90,000 litres** of rainwater in an average year of rain.

You can calculate what is the potential of rainwater harvesting in your area and have one appropriate for you. Rainwater harvesting has tremendous potential and it is up to each one of us to push this technique further for a sustainable water situation for India. ■

***(Author is Rain Water Harvesting Expert)**

Water Resources of India



■ **Rakesh Kumar** with
R. D. Singh &
K. D. Sharma

Water resources of a country constitute one of its vital assets. India receives annual precipitation of about 4000 km³. The rainfall in India shows very high spatial and temporal variability and paradox of the situation is that Mousinram near Cherrapunji, which receives the highest rainfall in the world, also suffers from a shortage of water during the non-rainy season, almost every year. The total average annual flow per year for the Indian river is estimated as 1953 km³. The total annual replenishable groundwater

resources are assessed as 432 km³. The annual utilizable surface water and groundwater resources of India are estimated as 690 km³ and 396 km³ per year, respectively. With rapid growing population and improving living standards the pressure on our water resources is increasing and per capita availability of water resources is reducing day by day. Due to spatial and temporal variability in precipitation the country faces the problem of flood and drought syndrome. Overexploitation of groundwater is leading to reduction of low flows in the rivers, declining of the groundwater resources, and salt water intrusion in aquifers of the coastal areas. Over canal-irrigation in some of the command areas has resulted in waterlogging and salinity.

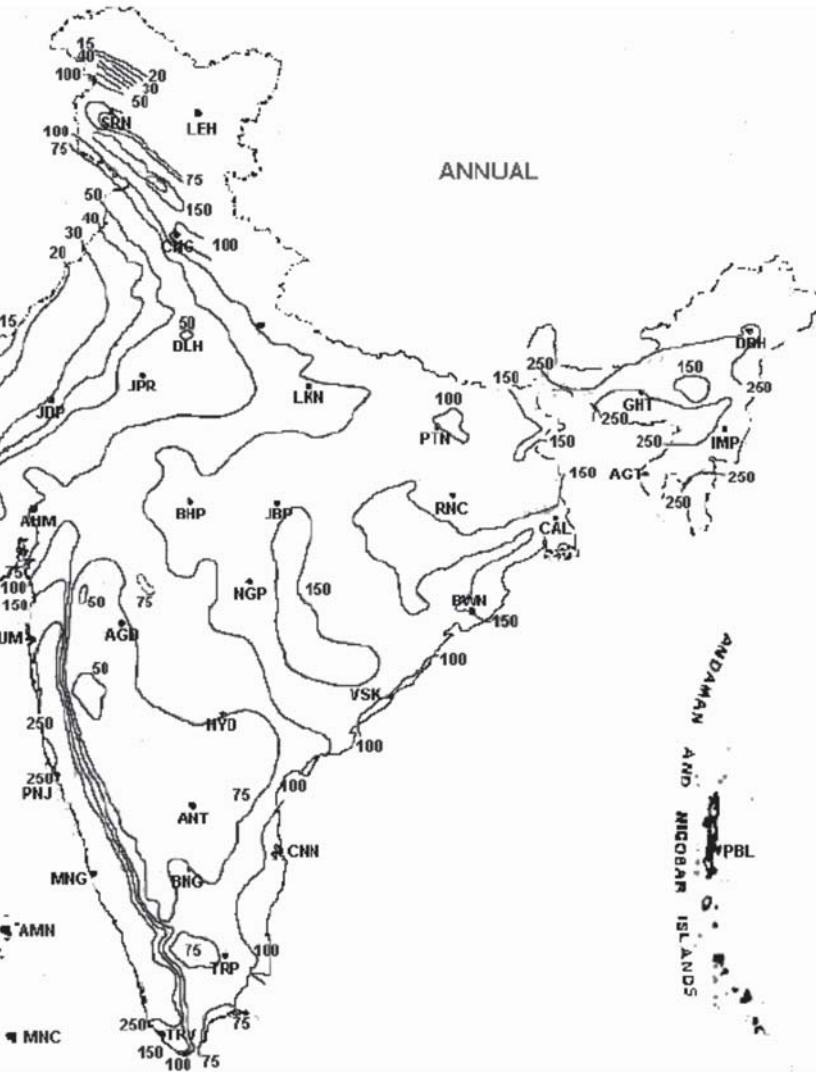
The quality of surface and groundwater resources is also deteriorating because of increasing pollutant loads from point and non-point sources. The climate change is expected to affect precipitation and water availability. So far, the data collection, processing, storage and dissemination have not received adequate attention. The efforts initiated under the Hydrology Project Phase-I and the development of the Decision Support System proposed under Hydrology Project Phase-II are expected to bridge some of the gaps between the developed advanced technologies of water resources planning, designing and management and their field applications. The paper presents availability and demands of water resources in India as well as describes

the various issues and strategies for developing a holistic approach for sustainable development and management of the water resources of the country. It also highlights integration of the blue and green flows and concepts of virtual water transfer for sustainable management of the water resources for meeting the demands of the present, without compromising the needs of future generations.

Water resources of India
Although India occupies only 3.29 million km² geographical area, which forms 2.4% of the world's land area, it supports over 15% of the world's population. The population of India as on 1 March 2001 stood at 1,027,015,247 persons. Thus, India supports about 1/6th of world population, 1/50th of world's land and 1/25th of world's water resources⁷. India also has a livestock population of 500 million, which is about 20% of the world's total livestock population. More than half of these are cattle, forming the backbone of Indian agriculture. The total utilizable water resources of the country are assessed as 1086 km³. A brief description of surface and groundwater water resources of India is given below.

Surface water resources

In the past, several organizations and individuals have estimated water availability for the nation. Recently, the National Commission for Integrated Water Resources Developments estimated the basin-wise average annual flow in Indian river systems as 1953 km³. The details are given in Table 1. Utilizable



Annual rainfall in India

water resource is the quantum of withdrawable water from its place of natural occurrence. Within the limitations of physiographic conditions and socio-political environment, legal and constitutional constraints and the technology of development available at present, utilizable quantity of water from the surface flow has been assessed by various authorities differently. The utilizable annual surface water of the country is 690 km³ (Table 1)⁹. There is considerable scope for increasing the utilization of water in the Ganga Brahmaputra basins by construction of storages at suitable locations in neighbouring countries.

Groundwater resources

The annual potential natural groundwater recharge from rainfall in India is about 342.43 km³, which is 8.56% of total annual rainfall of the country. The annual potential groundwater recharge augmentation from canal irrigation system is about 89.46 km³. Thus, total replenishable groundwater resource of the country is assessed as 431.89%. After allotting 15% of this quantity for drinking, and 6 km³ for industrial purposes, the remaining can be utilized for irrigation purposes. Thus, the available groundwater resource for irrigation is

It is expected that about 70% of urban water requirement and 30% of rural water requirement will be met by surface water sources and the remaining from groundwater.

361 km³, of which utilizable quantity (90%) is 325 km³. The estimates by the Central Groundwater Board (CGWB) of total replenishable groundwater resource, provision for domestic, industrial and irrigation uses and utilizable groundwater resources for future use are given in Table 2. The basinwise per capita water availability varies between 13,393 m³ per annum for the Brahmaputra-Barak basin to about 300 m³ per annum for the Sabarmati basin.

The state-wise estimates of dynamic groundwater (fresh) resource made by the CGWB¹⁰ are given in Table 3. The basin-wise groundwater potential of the country is given in Table 4. Water requirements of India Traditionally, India has been an agriculture-based economy. Hence, development of irrigation to increase agricultural production for making the country self-sustained and for poverty alleviation has been of crucial importance for the planners. Accordingly, the irrigation sector was assigned a very high priority in the 5-year plans. Giant schemes like the Bhakra Nangal, Hirakud, Damodar Valley, Nagarjunasagar, Rajasthan Canal project, etc. were taken up to increase irrigation potential and maximize agricultural production. Long-term planning has to account for the growth of population.

According to National Water Policy¹, the production of food grains has increased from around 50 million tonnes in the fifties to about 203 million tonnes in the year 1999-2000. A number of individuals and agencies have estimated the likely population of India by the year 2025 and 2050. According to the estimates adopted by NCIWRD⁹, by the year 2025, the population is expected to be 1333 million in high-growth scenario and 1286 million in low growth scenario. For the year 2050, high rate of population growth is likely to result in about 1581 million people while the low growth projections place the number at

nearly 1346 million. Keeping in view the level of consumption, losses in storage and transport, seed requirement, and buffer stock, the projected food-grain and feed demand for 2025 would be 320 million tonnes (high-demand scenario) and 308 million tonnes (low-demand scenario).

The requirement of food grains for the year 2050 would be 494 million tonnes (high-demand scenario) and 420 million tonnes (low-demand scenario). Table 5 provides details of the population of India and per capita water availability as well as utilizable surface water for some of the years from 1951 to 2050 (projected). The availability of water in India shows wide spatial and temporal variations. Also, there are very large inter annual variations. Hence, the general situation of availability of per capita availability is much more alarming than what is depicted by the average figures.

Domestic use

Community water supply is the most important requirement and it is about 5% of the total water use. About 7 km³ of surface water and 18 km³ of groundwater are being used for community water supply in urban and rural areas. Along with the increase in population, another important change from the point of view of water supply is higher rate of urbanization. According to the projections, the higher is the economic growth, the higher would be urbanization.

It is expected that nearly 61% of the population will be living in urban areas by the year 2050 in high-growth scenario as against 48% in low growth scenario. Different organizations and individuals have given different norms for water supply in cities and rural areas. The figure adopted by the NCIWRD⁹ was 220 litre per capita per day (lpcd) for class I cities. For the cities other than class I, the norms are 165 for the year 2025 and 220 lpcd for the year 2050. For

rural areas, 70 lpcd and 150 lpcd have been recommended for the years 2025 and 2050. Based on these norms and projection of population, it is estimated that by 2050, water requirements per year for domestic use will be 90 km³ for low demand scenario and 111 km³ for high demand scenario. It is expected that about 70% of urban water requirement and 30% of rural water requirement will be met by surface water sources and the remaining from groundwater.

Irrigation

The irrigated area in the country was only 22.6 million hectare (Mha) in 1950-51. Since the food production was much below the requirement of the country, due attention was paid for expansion of irrigation. The ultimate irrigation potential of India has been estimated as 140 Mha. Out of this, 76 Mha would come from surface water and 64 Mha from groundwater sources. The quantum of water used for irrigation by the last century was of the order of 300 km³ of surface water and 128 km³ of groundwater, total 428 km³. The estimates indicate that by the year 2025, the water requirement for irrigation would be 561 km³ for low-demand scenario and 611 km³ for high-demand scenario. These requirements are likely to further increase to 628 km³ for low-demand scenario and 807 km³ for high-demand scenario by 2050.

Hydroelectric power

The hydro power potential of India has been estimated at 84,044 MW at 60% load factor. At the time of independence, the installed capacity of hydro power projects was 508 MW. By the end of 1998, the installed hydro power capacity was about 22,000 MW. The status of hydro power development in major basins is highly uneven. According to an estimate, India has plans to develop 60,000 MW additional hydro power by the twelfth five-year plan. It includes 14,393 MW during the tenth five-year plan (2002-2007); 20,000 MW during eleventh (2007-2012) and 26,000 MW during the twelfth (2012-2017) five-year plans. A potential of the order of 10,000 MW is available for development of small hydro power projects in the Himalayan and sub-Himalayan regions

of the country. Therefore, it is not only desirable but also a pressing need of time to draw a master plan for development of small, medium and large hydro-schemes for power generation. *Industrial water requirement* Rough estimates indicate that the present water use in the industrial sector is of the order of 15 km³. The water use by thermal and nuclear power plants with installed capacities of 40,000 MW and 1500 MW (1990 figures) respectively, is estimated to be about 19 km³. In view of shortage of water, the industries are expected to switch over to water efficient technologies. If the present rate of water use continues, the water requirement for industries in 2050 would be 103 km³; this is likely to be nearly 81 km³ if water saving technologies are adopted on a large scale.

Total water requirements

Total annual requirement of water for various sectors has been estimated and its break up is given Table 6. With the increasing population as well as all round development in the country, the utilization of water has also been increasing at a fast pace. In 1951, the actual utilization of surface water was about 20% and 10% in the case of groundwater. The utilizable water in river basins is highly uneven. For example in the Brahmaputra basin, which contributes 629 billion m³ of surface water of the country's total flow, only 24 billion m³ is utilizable. Water resources management in India In view of the existing status of water resources and increasing demands of water for meeting the requirements of the rapidly growing population of the country as well as the problems that are likely to arise in future, a holistic, well planned long-term strategy is needed for sustainable water resources management in India. The water resources management practices may be based on increasing the water supply and managing the water demand under the stressed water availability conditions. Data monitoring, processing, storage, retrieval and dissemination constitute the very important aspects of the water resources management. These data may be utilized not only for management but

also for the planning and design of the water resources structures. In addition to these, now a days decision support systems are being developed for providing the necessary inputs to the decision makers for water resources management. Also, knowledge sharing, people's participation, mass communication and capacity building are essential for effective water resources management. Some important aspects of such strategies are described as follows.

Flood management

Among all natural disasters, floods are the most frequent to be faced in India. Floods in the eastern part of India, viz. Orissa, West Bengal, Bihar and Andhra Pradesh in the recent past, are striking examples. According to the information published by different government agencies, the tangible and intangible losses due to floods in India

There is every possibility that this figure may increase due to rapid growth of population and increased encroachments of the flood plains for habitation, cultivation and other activities. The main causes of floods in India are inadequate capacity within river banks to contain high flows, river bank erosion and silting of river beds. The additional factors are as land slides leading to obstruction of flow and change of the river course, retardation of flow due to tidal and backwater effects, poor natural drainage in the flood-prone area, cyclone and associated heavy rain storms or cloud bursts, snowmelt and glacial outbursts and dam break flows. After the disastrous floods of 1954 a national programme of flood management was launched. The Government of India has taken a number of steps for flood management. As stated by Mohapatra and Singh¹³, some of the important policies on flood management include:

Use	Year 1997–98	Year 2010			Year 2025			Year 2050		
		Low	High	%	Low	High	%	Low	High	%
Surface water										
Irrigation	318	330	339	48	325	366	43	375	463	39
Domestic	17	23	24	3	30	36	5	48	65	6
Industries	21	26	26	4	47	47	6	57	57	5
Power	7	14	15	2	25	26	3	50	56	5
Inland navigation	7	7	1	10	10	1	15	15	1	
Environment – Ecology	5	5	1	10	10	1	20	20	2	
Evaporation losses	36	42	42	6	50	50	6	76	76	6
Total	399	447	458	65	497	545	65	641	752	64
Groundwater										
Irrigation	206	213	218	31	236	245	29	253	344	29
Domestic	13	19	19	2	25	26	3	42	46	4
Industries	9	11	11	1	20	20	2	24	24	2
Power	2	4	4	1	6	7	1	13	14	1
Total	230	247	252	35	287	298	35	332	428	36
Grand total	629	694	710	100	784	843	100	973	1180	100
Total water use										
Irrigation	524	543	557	78	561	611	72	628	807	68
Domestic	30	42	43	6	55	62	7	90	111	9
Industries	30	37	37	5	67	67	8	81	81	7
Power	9	18	19	3	31	33	4	63	70	6
Inland navigation	0	7	7	1	10	10	1	15	15	1
Environment – Ecology	0	5	5	1	10	10	1	20	20	2
Evaporation losses	36	42	42	6	50	50	6	76	76	7
Total	629	694	710	100	784	843	100	973	1180	100

are increasing at alarming rate. As reported by the Central Water Commission (CWC) under the Ministry of Water Resources, Government of India, the annual average area affected by floods is 7.563 Mha. This observation is based on the data for the period 1953–2000 published in IWRS¹², with variability ranging from 1.26 Mha in 1965 to 1.75 Mha in 1978. On an average floods have affected about 33 million persons during 1953 to 2000.

policy statement (1954), high level committee on flood (1957), policy statement (1958), ministerial committee on flood control (1964), ministers committee on flood and flood relief (1972); working groups on flood control for five-year plans; Rashtriya Barh Ayog¹⁴, National Water Policy (1987), National Commission for Integrated Water Resource Development (1996), Regional Task Force (1996), and National Water Policy¹. The committees

and commissions constituted by the government have given valuable recommendations on different issues of flood management. Various types of structural and non-structural measures have been taken up to reduce the damages in the flood plains. The structural measures, such as the construction of embankments, levees, spurs, etc. have been implemented in some of the states. The total length of constructed embankments is 16,800 km and drainage channels are of 32,500 km. A total of 1040 towns and 4760 villages are currently protected against flood. Barring occasional breaches in embankments, these have provided reasonable protection to an area of about 15.07 Mha. A large number of reservoirs have been constructed and these reservoirs have resulted in reduction of intensity of floods. The non-structural measures such as flood forecasting and warning are also being adopted. The flood forecasting and flood warning in India commenced in 1958, for the Yamuna river in Delhi. It has evolved to cover most of the flood-prone interstate river basins in India. The CWC has established a flood forecasting system covering 62 major rivers with more than 157 stations for issuing flood forecasts covering almost all the flood-prone states. The response of state governments towards enactment of flood plain zoning bill is not encouraging. Though some of the states (e.g. Rajasthan and Manipur) have enacted the flood plain zoning legislation, the major flood-affected states (e.g. Assam, Himachal, Goa and Sikkim) have not considered such legislation. A working group of National Natural Resources Management System¹⁵ standing committee on water resources for flood risk zoning of major flood-prone rivers considering remote sensing input was constituted by the Ministry of Water Resources in 1999. The working group recommended flood risk zoning using satellite-based remote sensing with a view to giving thrust towards implementation of flood plain zoning measures¹⁵. The flood management measures have to be more focused and targeted towards the decided objectives within a stipulated time frame. For flood plain zoning,

methods have to be evolved in consultation with the local bodies so that the legislation on flood plain zoning is adopted. As suggested by the Working Group of tenth five-year plan that the possible apprehensions of difficulties in drafting a legislation should not become a bar to the idea of the approach of flood plain zoning itself. Flood forecasting constitutes one of the most important actions of flood disaster preparedness. Technical advancement in a well planned flood forecasting and warning system can help in providing higher lead time for timely action. It is well recognized that long-term solution of flood problems lies in creating appropriate flood storage in reservoirs. The total live storage capacity of

neighbouring countries, viz. Nepal, China, Bhutan, Pakistan, Bangladesh and Myanmar, bilateral cooperation for flood management is necessary for India and the concerned country. The government of India has taken some initiatives in this regard however, more active participation is required.

Groundwater management

To protect the aquifers from overexploitation, an effective groundwater management policy oriented towards promotion of efficiency, equity and sustainability is required. Agricultural holdings in India are highly fragmented and the rural population density is large. The exploitation of groundwater resources



completed projects in India is about 174 km³. A large flood storage space in reservoirs is required for a successful flood management programme. Flood management also calls for community participation. Farmers, professional bodies, industries and voluntary organizations have to be aware about flood management. People's participation in preparedness, flood fighting and disaster response is required. Media like radio, TV, newspapers can also play an important role in flood management. As India shares river systems with six

should be regulated so as not to exceed the recharging possibilities, as well as to ensure social equity. The detrimental environmental consequences of overexploitation of groundwater need to be effectively prevented by the Central and State Governments. Overexploitation of groundwater should be avoided, especially near the coasts to prevent ingress of seawater into freshwater aquifers¹⁶. Clearly, a joint management approach combining government administration with active people participation is a promising solution¹⁶. In critically overexploited areas, bore-

well drilling should be regulated till the water table attains the desired elevation. Artificial recharge measures need to be urgently implemented in these areas. Amongst the various recharge techniques¹⁷, percolation tanks are least expensive in terms of initial construction costs. Many such tanks already exist but a vast majority of these structures have silted up. In such cases, cleaning of the bed of the tank will make them reusable. Promotion of participatory action in rehabilitating tanks for recharging would go a long way in augmenting groundwater supply. Due to declining water table, the cost of extraction of groundwater has been increasing over time and wells often go dry. This poses serious financial burden on farmers. Hence, special programmes need to be designed to support these farmers. Finally, the role of government will have to switch from that of a controller of groundwater development to that of a facilitator of equitable and sustainable development. Shah¹⁸ mentions that three large-scale responses to groundwater depletion in India have emerged in recent years in an uncoordinated manner, and each presents an element of what might be its coherent strategy of resources governance as follows:

Energyirrigation nexus:

Throughout South Asia, the 'groundwater boom' was fired during the 1970s and 90s by government support to tubewells and subsidies to electricity supplied by state-owned electricity utilities to farmers. The invidious energyirrigation nexus that emerged as a result and wrecked the electricity utilities and encouraged waste of groundwater are widely criticized. However, hidden in this nexus is a unique opportunity for groundwater managers to influence the working of the colossal anarchy that is India's groundwater socio-ecology. Even while subsidizing electricity, many state governments have begun restricting power supply to agriculture to cut their losses. The International Water Management Institute Research has shown that with intelligent management of power supply to agriculture,

energyirrigation nexus can be a powerful tool for groundwater demand management in livelihood supporting socio-ecologies to create tradable poverty rights in groundwater. Mexico finally had to turn to electricity supply management to enforce its groundwater.

Inter-basin transfers to recharge unconfined alluvial aquifers

In western India's unconfined alluvial aquifers, it is being increasingly realized that groundwater depletion can be countered only by importing surface water, Arizonastyle. The Jiangsu province in eastern China has implemented its own little inter-basin water transfer from Yangtze to counter groundwater depletion in the Northern part. Similarly, one of the major uses Gujarat has found for water of the Sardar Sarovar Project on Narmada river is to recharge the depleted aquifers of North Gujarat and Kachchh. A key consideration behind India's proposed mega-scheme to link its northern rivers with peninsular rivers too is to counter groundwater depletion in western and southern India.

Mass-based recharge movement:

In many parts of hardrock India, groundwater depletion has invoked wildfire community-based mass movement for rainwater harvesting and recharge, which interestingly has failed to take off in unconfined alluvial aquifers. It is difficult to assess the social value of this movement partly because 'formal hydrology' and 'popular hydrology' have failed to find a meeting ground. Scientists want check dams sited near recharge zones; villagers want them close to their wells. Scientists recommend recharge tubewells to counter the silt layer impeding recharge; farmers just direct floodwaters into their wells after filtering. Scientists worry about upstream downstream externalities; farmers say everyone lives downstream. Scientists say the hardrock aquifers have too little storage to justify the prolific growth in recharge structures; people say a recharge structure is worthwhile if their wells provide even 1000 m³ of lifesaving

irrigation/ha in times of delayed rain. Hydrologists keep writing the obituary of the recharge movement; but the movement has spread from eastern Rajasthan to Gujarat, thence to Madhya Pradesh and Andhra Pradesh. Protagonists think that with better planning of recharge structures and larger coverage, decentralized recharge movement can be a major response to India's groundwater depletion because it can ensure that water tables in pockets of intensive use rebound close to pre-development levels at the end of the monsoon season every year they have a good monsoon, which is at least twice in five years. They surmise that this is not impossible because even today, India's total groundwater extraction is barely 5% of its annual precipitation. Shah¹⁸ mentions the following workable solutions for management of groundwater resources:

- Banning private wells is futile; crowd them out by improving public water supply.
- Regulating final users is impossible; facilitate mediating agencies to emerge, and regulate them.
- Pricing agricultural groundwater use is infeasible; instead, use energy pricing and supply to manage agricultural groundwater draft.
- No alternative to improved supply side management: better rain-water capture and recharge, imported surface water in lieu of groundwater pumping.
- Grow the economy, take pressure off land, and formalize the water sector.

Conjunctive use of surface and groundwater

Large canal infrastructure network for providing irrigation has been the prime goal of the Government of India, since the first five-year plan, which continued up to seventh five-year plan. In some of the irrigation project commands such as Sarda Sahayak in UP, Gandak in Bihar, Chambal in Rajasthan, Nagarjuna Sagar in Andhra Pradesh, Ghataprabha and Malaprabha in Karnataka etc., problems of water

logging are being faced. The main reason for excessive use of surface water as compared to groundwater is its much lower price for irrigation as compared to the cost incurred in using groundwater. Water logging problems could be overcome if conjunctive use of surface and groundwater is made. Groundwater utilization for irrigation in waterlogged areas can help to lower the groundwater table and reclaim the affected soil. Over exploitation of groundwater in areas like Mehsana, in Gujarat; parts of Meeurt and Varanasi districts in Uttar Pradesh, Coimbatore in Tamil Nadu and Karnal district in Haryana etc. have resulted in mining of groundwater²⁰. Many research workers have focused the causes of waterlogging²¹. Several groundwater flow modelling studies have focused on assessing the waterlogged areas and measures to control problems of waterlogging and salinization^{22,23}. It is desirable that the irrigation needs for fulfilling crop water requirements should be satisfied by judicious utilization of available canal water in conjunction with groundwater so as to keep the water table within the acceptable range. Thus, the optimal conjunctive use of the region's surface and groundwater resources would help in minimizing the problems of water logging and groundwater mining.

Water conservation

Water conservation implies improving the availability of water through augmentation by means of storage of water in surface reservoirs, tanks, soil and groundwater zone. It emphasizes the need to modify the space and time availability of water to meet the demands. This concept also highlights the need for judicious use of water. There is a great potential for better conservation and management of water resources in its various uses. On the demand side, a variety of economic, administrative and community-based measures can help conserve water. Also, it is necessary to control the growth of population since large population is putting massive stress on all natural resources. Since agriculture accounts for about 69% of all water withdrawn, the greatest potential for conservation lies in

increasing irrigation efficiencies. Just a 10% improvement in irrigation efficiency could conserve enough water to double the amount available for drinking. In India, sprinkler irrigation is being adopted in Haryana, Rajasthan, Uttar Pradesh, Karnataka, Gujarat and Maharashtra. The use of sprinkler irrigation saves about 56% of water for the winter crops of bajra and jowar, while for cotton, the saving is about 30% as compared to the traditional gravity irrigation. An important supplement to conservation is to minimize the wastage of water. In urban water supply, for example, almost 30% of the water is wasted due to leakages, carelessness, etc. while most metro cities face deficit in supply of water. It is, therefore, imperative to prevent wastage. In industries also, there is a scope for economy in the use of water. Prices of water for all uses should be fixed, keeping in mind its economic value, control of wastage, and the ability of users to pay. As water is becoming scarcer, pricing will be an important factor in avoiding wastage and ensuring optimal use.

Watershed management

For an equitable and sustainable management of shared water resources, flexible, holistic approach of Integrated Water Resources Management (IWRM) is required, which can cater to hydrological variations in time and space and changes in socio-economic needs along with societal values. Watershed is the unit of management in IWRM, where surface water and groundwater are inextricably linked and related to land use and management. Watershed management aims to establish a workable and efficient framework for the integrated use, regulation and development of land and water resources in a watershed for socio-economic growth. Local communities play a central role in the planning, implementation and funding of activities within participatory watershed development programmes. In these initiatives, people use their traditional knowledge, available resources, imagination and creativity to develop watershed and implement

community-centered programme. Currently, many programmes, campaigns and projects are underway in different parts of India to spread mass awareness and mobilize the general population in managing water resources.

Some of these are being implemented by the Central/State Governments, while others have been taken up by various Non-Governmental Organizations (NGOs). For example, Hariyali (meaning 'greenery') is a watershed management project, launched by the Central Government, which aims at enabling the rural population to conserve water for drinking, irrigation, fisheries and afforestation as well as generate employment opportunities. The project is being executed by the Gram Panchayats (village governing bodies) with people's participation; the technical support is provided by the block (sub-district) administration. Another good example of water conservation efforts is the 'Neeru-Meetu' (Water and You) programme launched in May 2000 by the Government of Andhra Pradesh. During the last three years, an additional storage space of more than 18,000 lakh m³ has been created by constructing various water-harvesting structures such as percolation tanks, dugout ponds, check dams, etc. through peoples' participation.

Tarun Bharat Sangh (Young India Association) or TBS is an NGO which promotes sustainable water management through rainwater harvesting in Rajasthan. Since 1986, TBS has helped in building or restoring nearly 10,000 water harvesting structures in Alwar and neighbouring districts in the Aravalli hills of northeastern Rajasthan. The central message of TBS is that good water management requires good land management. Emphasis is also put on protecting forests. The efforts of villagers are visible in the form of rising water table and regenerated forests on the rocky slopes of Aravalli hills. Despite some of the above success stories, so far there is no appreciable improvement on watershed resources utilization at national level. Undoubtedly, coordinated watershed

development programmes need to be encouraged and awareness about benefits of these programmes must be created among the people. *Rainwater harvesting* Rainwater harvesting is the process to capture and store rainfall for its efficient utilization and conservation to control its runoff, evaporation and seepage. Some of the benefits of rainwater harvesting are:

- It increases water availability
- It checks the declining water table
- It is environmentally friendly
- It improves the quality of groundwater through dilution, mainly of fluoride, nitrate, and salinity, and
- It prevents soil erosion and flooding, especially in the urban areas.

Even in ancient days, people were familiar with the methods of conservation of rainwater and had practised them with success. Different methods of rainwater harvesting were developed to suit the geographical and meteorological conditions of the region in various parts of the country. Traditional rainwater harvesting, which is still prevalent in rural areas, is done by using surface storage bodies like lakes, ponds, irrigation tanks, temple tanks, etc. For example, *Kul* (diversion channels) irrigation system which carries water from glaciers to villages is practised in the Spiti area of Himachal Pradesh. In the arid regions of Rajasthan, rainwater harvesting structures locally known as *Kund* (a covered underground tank), are constructed near the house or a village to tackle drinking water problem.

In Meghalaya, *Bamboo Rainwater Harvesting* for tapping of stream and spring water through bamboo pipes to irrigate plantations is widely prevalent. The system is so perfected that about 1820 litres of water entering the bamboo pipe system per minute is transported over several hundred meters. There is a need to recharge aquifers and conserve rainwater through water harvesting structures. In urban areas, rainwater will have to be harvested using rooftops and open spaces. Harvesting rainwater not only reduces the possibility of flooding, but also decreases the community's dependence on groundwater for domestic uses. Apart

from bridging the demand supply gap, recharging improves the quality of groundwater, raises the water table in wells/bore-wells and prevents flooding and choking of drains. One can also save energy to pump groundwater as water table rises. These days rainwater harvesting is being taken up on a massive scale in many states in India. Substantial benefits of rainwater harvesting exist in urban areas as water demand has already outstripped supply in most of the cities.

Water quality conservation and environment restoration

Implementation of water pollution prevention strategies and restoration of ecological systems are integral components of all development plans. To preserve our water and environment, we need to make systematic changes in the way we grow our food, manufacture the goods, and dispose off the waste²⁴. In India, agriculture is the biggest user and polluter of water. If pollution by agriculture is reduced, it would improve water quality and would also eliminate cost incurred for treatment of diseases. Like all other inputs, there is an optimal quantity of fertilizer for given conditions and excess application does not improve the crop yield. Pricing of fertilizers and pesticides as well as appropriate legislation to regulate their use will also go a long way in stopping indiscriminate use. Industries need to carefully treat their waste discharges. Manufacturers may reduce water pollution by reusing materials and chemicals and switching over to less toxic alternatives. Industrial symbiosis, in which the unusable wastes from one product/firm become the input for another, is an attractive solution. Also, there is a need to encourage reductions or replacement of toxic chemicals, possibly through fiscal measures. Pollution taxes in the Netherlands, for example, have helped the country slash discharges of heavy metals such as mercury and arsenic into waterways by up to 99% between 1976 and the mid-1990s.

Many countries discourage use of equipment, such as thermometers that contain mercury. Such measures in India would also be helpful. For this purpose,

society and individuals should have a greater knowledge and ability to bring about the required changes. Widely and readily available technical help about 'how to do this' will accelerate the process. Environmental improvement and restoration should be planned and implemented such that the freshwater resources are protected and their quality is maintained and/or enhanced. A broad perspective is needed that unites social, economic and environmental concerns in a landscape where upland forests and rangeland, wetlands, agricultural and urban areas are integrated. An understanding of watershed linkages allows long-term and sustainable solutions to a variety of natural resource problems. Model efforts in this direction include the capture, storage and safe release of water and the prevention of accelerated soil erosion through the structures and vegetation. While utilizing water and land resources, their ability to serve other uses is often degraded either inadvertently or due to carelessness. Efforts should be made to restore landscapes and ecosystems to more efficiently protect water quality, aquatic and wildlife. On the legislative front, laws are required to check littering as well as to implement 'polluter pays' principle. More importantly, these laws should be strictly enforced.

Recycle and reuse of water

Another way through which we can improve freshwater availability is by recycle and reuse of water. It is said that in the city of Frankfurt, Germany, every drop of water is recycled eight times. Use of water of lesser quality, such as reclaimed wastewater, for cooling and fire fighting is an attractive option for large and complex industries to reduce their water costs, increase production and decrease the consumption of energy. This conserves better quality waters for potable uses. Currently, recycling of water is not practised on a large scale in India and there is considerable scope and incentive to use this alternative. Estimates²⁵ show that recyclable water is between 103 and 177 km³/year for low and high population projections. ■

***(Author's are Associated with IIT Roorkee, U.P.)**

Water in Rajasthan

■ M. S. Rathore



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Rajasthan's economic growth is largely dependent on water, more specifically on groundwater. 71% of the irrigation and 90% of the drinking water supply source is groundwater (Rathore 2003). Presently, there is tremendous pressure to exploit groundwater by State and private users, i.e. by those who have access and control over this limited resource. The resulting consequences are also well known - in 2001, out of 236 groundwater zones, only 20.8% were categorized as safe. The rest reached the stage of being categorized as semi-critical (8.9%), critical (33.9%) and over-exploited (36.4%). The causes of groundwater depletion and pollution are rooted in population growth, economic expansion, decline in groundwater recharge and over-abstraction caused by the rapid increase in the number of wells and tubewells and the progress in pumping technology.

In response to this grave groundwater situation, numerous efforts were initiated by the State government, NGO's and civil society, such as the construction of dams, tanks and traditional water harnessing systems, and, the most important initiative: the watershed management program. What is lacking is any scientific evaluation of these interventions in terms of their impact on groundwater augmentation. In this study, an attempt has been made to review the status of groundwater in Rajasthan and document the results of groundwater augmentation studies in

the State.

In the first part of this study, the historical background of groundwater in the State is discussed followed by a description of the geology, geohydrology, rainfall and other relevant factors affecting groundwater that are helpful in understanding the present situation. The next section presents a review of studies documenting the impacts of groundwater augmentation efforts in the State. Finally, some recommendations are given for future activities to improve the groundwater

movement of groundwater. Over the years, the study of groundwater has focused singularly on understanding the occurrence and movement of water in these environments in order to develop and manage the resource. Besides understanding the hydrogeological framework in which groundwater occurs and assessing its utilizable component, an equally important concern is assessing its quality. If groundwater is to play a lead role in development, then it will have to be protected from increasing threats of depletion and contamination. The



situation in the State.

Historical Background

The surface water resources of Rajasthan are meager and the entire state is principally dependent on groundwater for its water needs. The hydrogeologic environment controls the occurrence, distribution and

growth of population, industry and agriculture coupled with increasing urban development has, for the first time in history, resulted in over-abstraction of groundwater and production of enormous quantities of waste. The management of groundwater is a complex job that must be efficiently handled, given the

concerns of the economic impacts of groundwater development and allocation amongst competing users. Groundwater management should be done in a systematic manner rather than the focus on individual pump capacity that has been the trend in the past.

Rajasthan is a landlocked state of 342,239 km² situated between latitudes 23°3' to 30°12' N and longitudes 69° 30' to 78° 17' E. It experiences varied climatic conditions ranging from extreme aridity in the northwestern parts (Jaisalmer) to sub-humid conditions in the southeastern parts (Jhalawar and Banswara) and humid conditions in the isolated Mount Abu region. However, most of the state (94.0%) falls under arid and semi-arid conditions with low and erratic rainfall patterns. Physiographically, western Rajasthan is covered in sand and dunes while the eastern, southern and southeastern parts are rocky and hilly with very few alluvial plains. Surface water sources are meager and the entire state has always been principally dependent on groundwater for its water needs.

During British India, almost the entire state of Rajasthan belonged to a large number of autonomous or semi-autonomous princes. Consequently, comprehensive efforts to cope with the urgent need for water were impossible, despite the rapid progress in groundwater exploration and exploitation. Efforts to exploit groundwater were made by individuals who dug deep wells by hand in rocky and alluvial/sandy areas to obtain small quantities of water. Throughout Rajasthan, especially in the western districts, dug wells and open wells were few and sparse, and most yielded very small quantities of water. Water was encountered at depths up to 122 m belowground with saturation depths of not more than one to one-and-a-half meters. The wells were dug by hand and the groundwater finally obtained was saline. Rural inhabitants had to travel long distances to fetch drinking water. The drinking water

situation in eastern Rajasthan was different because of hilly terrain and higher rainfall, which made collecting water easier, but even there wells yielded quantities too low to meet agricultural requirements.

After the advent of railways, in a few places water was supplied by train tanker, especially in desert areas. The first scientific exploration of groundwater in Rajasthan occurred in 1921 by G.H. Tipper who investigated the water supply for the Jodhpur-Bikaner Railways (Taylor *et al.* 1955). After independence in 1942, the Government of India and the State Government of Rajasthan undertook groundwater exploration, exploitation and management programs through various central and state agencies. These were the:

- i Geological Survey of India
- ii Exploratory Tubewells Organization
- iii Central Ground Water Board
- iv Central Arid Zone Research Institute, Indian Council of Agriculture Research
- v Ground Water Department, Government of Rajasthan
- vi Public Health Engineering Department, Government of Rajasthan
- vii Sanitation, Water and Community Health Project
- viii Rajasthan Jal Vikas Nigam Ltd.
- ix Other NGOs and private individuals.

Various development programs were supported with funding made available by financial institutions for drilling and mechanizing wells and with professional assistance for locating the best sites for them. The number of open wells and tubewells increased dramatically from 1957/58 to 1999/2000 (see Table 1). The density of wells increased from 1,489 wells per 1,000 km² in 195/57 to 3,944 in

1999/2000.

The first groundwater potential estimates were made during 1983/84 and were repeated in 1987, 1990, 1992, 1996, 1998 and 2001. Despite an increase in the area of groundwater potential due to more exploratory studies, there has been a total decline of 39.89% in the groundwater potential. As a result, 'safe' water zones, i.e. those safe for exploitation, declined from 86% in 1984 to 20.7% in 2001, and in 2001, 70.3% of all groundwater potential zones were classified as 'dark' and 'gray' (Tables 2 and 3).

Categorization of areas for groundwater development

Groundwater development can be categorized based on the stage of development and the long-term trend of pre- and post-monsoon groundwater levels. The following categorization is adopted by the Ground Water Department in Rajasthan.

Safe areas with potential for development

(a) Areas where groundwater resource assessments show the stage of groundwater development to be 70% or lower and where there is no significant long-term decline of pre- or post-monsoon groundwater levels.

(b) Areas where groundwater resource assessments show the stage of groundwater development to be more than 70% but less than 90% and where both pre- and post-monsoon groundwater levels do not show a significant long-term decline. However, in these areas, caution should be exercised in plans for future development

with regard to quantities of additional groundwater withdrawn.

Semi-critical areas for cautious groundwater development

Areas where groundwater resource assessments show the stage of groundwater development to be more than 70% but less than 90% and where either pre- or post-monsoon groundwater levels show a significant long-term decline.

Critical areas

- (a) Areas where groundwater resource assessments show the stage of groundwater development to be more than 90% but less than 100% and where either pre- or post-monsoon groundwater levels show a significant long-term decline.
- (b) Areas where groundwater stage of groundwater development to resource assessments show the

be less than 100%, but where both pre- and post-monsoon groundwater levels show a significant long-term decline.

- (c) Areas where groundwater resource assessments show the stage of groundwater development to be more than 100%, but where either pre- or post-monsoon groundwater levels do not show a significant long-term decline.

Over-exploited areas

Areas where groundwater resource

Table 1 District-wise density of wells/1,000 km² in Rajasthan, 1956-2000

Districts	Density of wells (all types) /1,000 km ²					
	1956-57	1961-62	1971-72	1981-82	1999-2000	1999-2000 (tubewells only)
WESTERN REGION						
Barmer	64	137	154	300	653	25
Jaisalmer	1	9	12	54	12	1
Bikaner	19	28	43	—	45	27
S. Ganganagar	2	—	2	66	0	566
Churu	2	5	18	125	345	48
Nagaur	427	440	508	883	2,602	267
Jodhpur	188	259	300	432	850	475
Pali	1,964	2,129	2,092	2,620	4,007	98
Jalore	768	994	1,106	2,272	5,281	76
Hanumangarh	—	—	—	—	55	1,310
NORTHEASTERN REGION						
Sikar	2,145	1,771	1,919	2,984	6,936	21
Jhunjhunu	765	838	940	2,602	6,957	0
Alwar	2,360	2,363	3,566	5,590	9,299	3,170
Jaipur	5,051	5,113	5,800	7,047	11,928	48
Ajmer	3,366	4,919	5,363	5,903	8,860	45
Tonk	2,954	3,275	3,638	4,786	7,042	35
S. Madhopur	2,598	2,324	2,918	3,859	6,396	282
Bharatpur	3,414	2,326	3,359	1,301	4,374	6,352
Dholpur	—	—	—	—	5,480	2,430
Dausa	—	—	—	—	13,075	1,366
Karauli	—	—	—	—	6,116	1,013
SOURTHEN REGION						
Bhilwara	6,495	6,845	7,539	7,820	11,862	46
Chittorgarh	4,028	4,365	5,317	6,322	9,729	639
Udaipur	3,858	4,090	4,545	4,921	5,315	39
Sirohi	1,443	1,557	1,723	2,221	3,645	0
Banswara	821	772	1,456	2,026	4,331	22
Dungarpur	738	938	2,051	2,429	7,712	50
Bundi	2,480	2,428	2,346	2,960	4,538	407
Kota	1,503	1,376	1,690	2,717	3,530	729
Jhalawar	3,400	3,737	4,732	6,625	11,435	148
Rajsamand	—	—	—	—	12,903	65
Baran	—	—	—	—	4,890	605
Rajasthan total	1,489	1,558	1,722	1,822	3,944	395

Source: State and Central Ground Water Board reports for various years, Government of Rajasthan and Government of India, Jaipur; Chatterji, P.C.(1993), 'Status of Ground Water in Rajasthan – Retrospect and Prospect', Institute of Development Studies, Volume III, pp. 500.

Table 2 Groundwater resource estimation in Rajasthan (mcm)

Item	Year				
	1984	1990	1995	1998	2001
Gross groundwater recharge	16,224	12,708	13,157	12,602	11,159
Net groundwater draft: (1) Irrigation (2) Domestic & Industrial	4,929.7 2,109*	5,423 1,994*	9,085 696	11,036 983	10,454 1,181
Gross draft (1) + (2)	7,039	7,417	9,916	12,019	11,635
Groundwater balance	8,799	5,239	4,535	3,894	- 476
Stage of groundwater development (%)	36	54	59	69	104

Source: Ground Water Department and Central Ground Water Department, Report of the Group on the Estimation of Ground Water Resources of Rajasthan (as on 1/1/2001), April 2002.

* Draft for drinking and industrial use is around 15% of gross water resources.

Table 3 Status of groundwater in Rajasthan

Year	Block (area unit)	Number of zones (figures in brackets are %)			
		Safe (White)	Semi-critical (Semi Gray)	Critical (Gray)	Over-exploited (Dark)
1984	236	203 (86.0)	10 (4.2)	11 (4.7)	12 (5.1)
1988	226	122 (54.0)	42 (18.6)	18 (8.0)	44 (19.5)
1990	236	148 (62.7)	31 (13.1)	13 (5.5)	44 (18.6)
1992	236	149 (63.1)	19 (8.1)	15 (6.4)	53 (22.5)
1995	236	127 (53.8)	35 (14.8)	14 (5.9)	60 (25.4)
1998	233	135 (57.9)	34 (14.6)	23 (9.9)	41 (17.6)
2001	236	49 (20.8)	21 (8.9)	80 (33.9)	86 (36.4)

Source: Ground Water Department and Central Ground Water Department, Report of the Group on the Estimation of Ground Water Resources of Rajasthan (as on 1/1/2001), April 2002

assessments show the stage of groundwater development to be greater than 100% and where both pre- and post-monsoon groundwater levels show a significant long-term decline.

Stage of groundwater development

The stage of groundwater development, indicated as a percentage, is defined by:

$$\frac{\text{Existing gross groundwater draft} \times 100}{\text{Net annual groundwater availability}}$$

Geohydrology of Rajasthan

Rajasthan lies over some of the oldest rock formations in India. The State has a heterogeneous assemblage of geological formations

ranging from the oldest Archean to recent alluvium and blown sand (Heron 1936, 1953; Sharma 1992). All of the lithological units have some groundwater potential; however, the water potential of these formations depends on their hydrogeological characteristics and structural control.

The groundwater potential areas in Rajasthan are not widespread and homogenous, but found as isolated basins with unique hydrological parameters. Also, the quality of the groundwater depends entirely on the sitespecific physical properties of the formation, the extent and nature of

weathering, and other specifics. There is considerable knowledge of the regional geological formations and megastructures, and of the extent of weathering. However, the information generated is inadequate to correlate with the groundwater potential of any specific area.

Geomorphological Characteristics

According to Singh *et al.* (1990), the geomorphological characteristics of Rajasthan can be broadly divided into four major geomorphic regions. These are, from west to east,
(1) the Rajasthan desert,

- (2) the Aravalli Mountains,
- (3) the east Rajasthan plains and
- (4) the southeastern plateau.

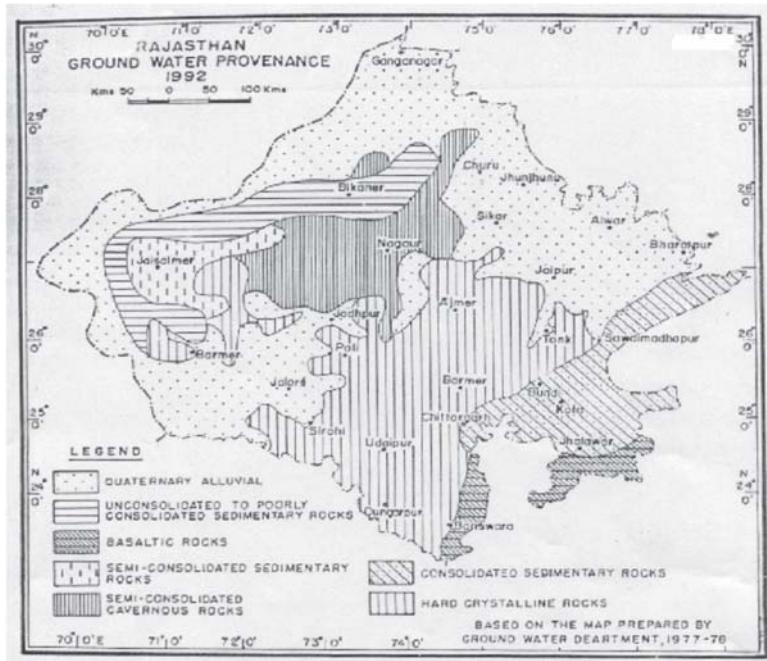


Figure 1 Groundwater Provinces in Rajasthan

information and precise hydrogeological characteristics such as optimum yield, drawdown, recovery rate, porosity,

Hydrogeological Conditions

Hydrogeological characteristics of the various lithological formations, such as depth of groundwater, yield, etc., are of vital importance in studying the groundwater potential in any area. The State Ground Water Department (SGWD), in 1977/78, identified 28 types of aquifer and grouped them into 13 hydrogeological zones. Subsequently, better data and information on hydrological properties of various aquifers and their extent were generated and these groups were reclassified (Chatterji 1993). Based on detailed information of these 13 aquifer types, the SGWD divided the State into seven provenances, each with similar groundwater characteristics, including water quality (Figure 1). These provenances are: hard crystalline rock, consolidated sedimentary rock, semi-consolidated cavernous rock, semi-consolidated sedimentary rock, basaltic, unconsolidated to poorly consolidated sedimentary rock and alluvial. However, despite good data, water yield data is based on water lifting devices installed in the wells. There is a gap in

information and precise hydrogeological characteristics such as optimum yield, drawdown, recovery rate, porosity,

Table 4 Revised groundwater potential zone

Formations	Number of				Notation
	Zone	Sub-zones	Sub-sub-zones	Total	
GROUP I – UNCONSOLIDATED					
Younger alluvium	32	16	2	50	A
Older alluvium	71	48	20	139	Ao
GROUP II – TERTIARY FORMATIONS					
Tertiary sandstone and gravel	—	—	—	—	T
Tertiary formations (mixed aquifer)	3	13	—	16	T
GROUP III – CONSOLIDATED SEDIMENTARY FORMATIONS					
Parewar formations	—	2	—	2	P
Bhadesar formations	—	3	—	3	Bh
Lathi formations	1	8	—	9	L
Sandstone (M.SG/Vindhyan's)	35	8	27	70	SS
Shale (M.SG/Vindhyan's)	9	8	—	17	Sh
Limestone (M.SG/Vindhyan's /Aravallis/Delhi etc.)	17	8	16	41	LS
Slate (M.SG/Vindhyan's/ Aravallis etc.)	2	—	—	2	SL
GROUP IV – CRYSTALLINES – IGNEOUS FORMATIONS					
Basalt	14	—	—	14	B
Rhyolite (Malani)	5	—	—	5	R
Granite (Malani/ post-Delhi/Aravallis)	14	20	—	34	Gr
Ultra basic (Dolomite/Diorite)	1	—	—	1	Ub
GROUP V – METAMORPHICS					
Quartzite (Delhi/Aravalli)	24	2	—	26	Q
Schist/Phyllites (Calc/Mica/Biotite)	72	16	—	88	Sc/Ph
Gneisses/B.G.C.	46	20	—	66	Gn.

permeability and transmissivity have not been adequately determined. Systematic hydrological investigations in the State of Rajasthan were initiated in 1965 and completed in 1972. From preliminary investigations, regional maps depicting the hydrogeology, depth to water, chemical quality of the groundwater and groundwater potential zones (phreatic) were prepared. These maps divided the State into 90 basins. Semi-detailed hydrogeological surveys to estimate the dynamics of groundwater resources and approximately quantify the groundwater potential of the State were initiated in 1972 on a block basis. These were short-term, one-year studies, completed in 1976. The findings of these surveys proved helpful in launching systematic groundwater development programs such as the

Minor Irrigation Scheme, Rural Electrification Scheme/SPA Scheme, Cattle Drinking Water Supply Scheme and the construction of wells for individuals. From these and subsequent, more detailed, hydrogeological surveys and drilling programs, groundwater potential zones able to receive recharge and transmit water were delineated.

These zones were categorized into thirteen groups. Hilly and inaccessible areas and areas with saline water or poor yield potential are not included. A total of 766 groundwater potential zones were identified and demarcated in 1977/78. The number of groundwater potential zones has since been reduced to 583 by merging zones of 50 km² or less with the neighboring zone. Groundwater

potential zones are periodically revised based on further surveys and exploratory drilling programs.

For greater clarity of classification, groundwater potential zones have now been divided into five groups, 15 zones, 13 sub-zones and 94 sub-sub zones (see Table 4). The sub and subsub zones are based on variation in discharge and quality of water (Table 5). The first and second estimates were made during 1984 and 1988 but the area determined during 1990 increased by 10.67% and 14.14% over 1984 and 1988 years, i.e., the coverage improved in the subsequent years of estimation. Detailed, long-term hydrogeological investigations for delineating aquifers, studying their geometry and hydrological parameters, and identifying the dynamic and static groundwater resources were undertaken in 1976. These studies investigated hydrogeological, hydrogeochemical, hydro-meteorological and geophysical aspects over at least one hydrologic cycle and involved exploratory drilling. Shortage of funds prevented these studies from being undertaken in a large number of basins simultaneously.

The studies in western Rajasthan were mainly financed under the Desert Development Programme (DDP)/Drought Prone Area Development Programme (DPAP), whereas in eastern Rajasthan they were financed under the State Plan Scheme.

Hydro-geomorphology and Groundwater Development/Recharge

Besides rainfall and lithological characteristics, the development of groundwater aquifers and recharge to such aquifers is largely determined by the geomorphic properties of the land, especially slope, drainage patterns and the nature and thickness of the unconsolidated/semiconsolidated layers over the bedrock formations. A

Table 5 Characteristics of groundwater potential zones

Code	Zone	Sub-code	Aquifer	Nature of Aquifer	Suitable for
A	Unconsolidated Aquifer	A1	Younger alluvium	Intercalated clay layers, moderately permeable	Tubewells
		A2	Younger and old alluvium	Appreciable clay contents, low permeability	Tubewells
		A3	Older alluvium	Dominantly argillaceous, calcareous, poor permeability	Ring wells, dug wells
B	Semi-consolidated to consolidated Aquifer	B1	Tertiary sandstone	Medium to coarse grained	Tubewells
			Occasional limestone	arenaceous, moderate permeability	Tubewells
		B2	Vindhyan sandstone	Medium grained intercalation of shales, moderate to low permeability	Tubewells
		B3	Vindhyan sandstone	Fine grained, compact, poor permeability	Dug well, tubewell
		B4	Vindhyan limestone	Partly cavernous, moderate to low permeability	Tubewell, dug well
C	Consolidated Metamorphic Aquifer	C1	Quartzite/ Sandstone/ Phyllite/ Schists/ Granite and acid intrusive	Moderate secondary permeability due to extensive weathering and fractured zones	Wide diameter, tubewells/ dug wells
		C2	Quartzite/Gneisses/ Slate/Shale/Basic & Ultra basic intrusives	Low secondary permeability due to limited fractured zones	Tubewells, wide diameter
					Dug-cum-bore wells
		C3	Quartzite/ Gneisses/Slate/ Shales/Basic & ultra basic intrusives	Compact poor permeability	Revitalization of dug wells by blasting, lateral drilling, etc.
D	Detailed hydrological investigations are in progress				
E	Area not suitable for further groundwater development due to meager potential, unsuitable water quality and inaccessibility				
F	Hills				

Source: Ground Water Department Map, "Ground Water Potential Zones", 1977/78

Table 6 Potential area (km²) capable of receiving recharge

District	District size	Potential recharge area	Potential area as a % of the district	Unproductive recharge area	Unproductive area as a % of the district
Ajmer	8,481	7,466.76	88.04	1,014.24	11.96
Alwar	8,380	6,843.81	81.67	1,536.19	18.33
Banswara	5,037	4,289.42	85.16	747.58	14.84
Barmer	28,387	13,492.32	47.32	14,894.68	52.47
Bharatpur	5,100	3,412.52	66.91	1,687.48	33.09
Bhilwara	10,455	9,354.84	89.48	1,100.16	10.52
Bikaner	27,244	11,561.00	42.43	15,683.00	57.57
Bundi	5,550	4,240.18	76.40	1,309.82	23.60
Chittorgarh	10,856	8,277.87	76.25	2,578.13	23.75
Churu	16,830	6,440.34	38.27	10,389.66	61.73
Dholpur	3,000	2,231.35	74.38	768.65	25.62
Dungarpur	3,770	2,649.00	70.26	1,121.00	29.74
Jaipur	14,068	12,623.29	89.73	1,444.71	10.27
Jaisalmer	38,401	9,027.76	23.61	29,373.24	76.49
Jalore	10,640	7,520.64	70.68	3,119.86	29.32
Jhalawar	6,219	6,106.16	98.18	112.84	1.82
Jhunjhunu	5,728	5,153.22	89.96	574.78	10.04
Jodhpur	22,850	16,606.51	72.68	6,243.49	27.32
Kota	12,436	12,015.38	96.62	420.62	3.38
Nagaur	17,718	15,106.28	85.26	2,611.72	14.74
Pali	12,387	7,362.54	59.44	5,024.46	40.56
S.Madhopur	10,527	8,670.05	82.36	1,856.95	17.64
Sikar	7,732	6,957.04	89.97	774.96	10.63
Sirohi	5,136	4,075.71	79.35	1,060.29	20.65
S. Ganganagar	20,634	2,078.16	10.07	21,555.84	89.93
Tonk	7,194	6,525.71	90.71	668.29	9.29
Udaipur	17,279	12,467.86	72.15	4,811.14	27.85
Rajasthan total	342,039	212,555.72	62.14	129,488.28	37.86

Source: Chatterji, P.C. (1993), 'Status of Ground Water in Rajasthan – Retrospect and Prospect', Institute of Development Studies, Volume I, pp. 96.

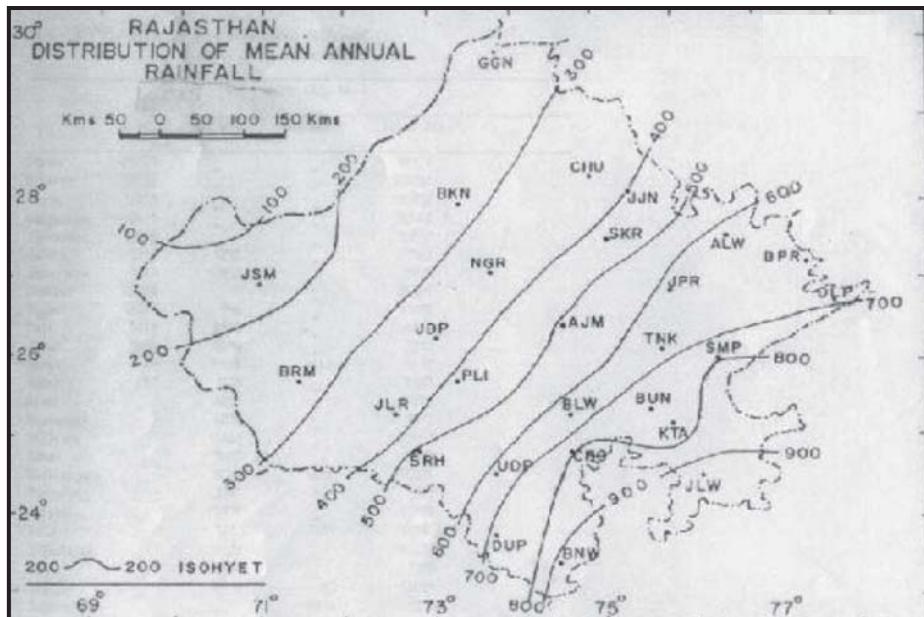


Figure 2 Distribution of annual rainfall in Rajasthan.

Rainfall and Groundwater

While recognizing the importance of the factors discussed above in understanding the status and potential of groundwater, ultimately it is the rainfall distribution and quality that determines groundwater availability. Rajasthan can be divided into three rainfall zones: arid, semi-arid and sub-humid (Figure 2). The total area classified as arid is 196,149 km² (58% of the state), as semi-arid is 121,016 km² (36%), and as sub-humid is 21,248 km² (6%). Rainfall distribution is highly variable, both in time and space. Annual rainfall across the state varies from more than 900 mm in the southeastern part to less than 100 mm in the west (Tables 7 and 8). Only the Mount Abu region receives more than 1,593 mm of rain a year due to its elevation, but this localized heavy rainfall over such a small region is not considered to influence the climatic conditions of the neighboring regions, which are sub-humid to semi-arid. The Mount Abu region is therefore often not included in the regional climatic classification.

The current practice to estimate recharge through rainfall assumes various natural factors. These factors are always site-specific and depend on the physiographic setting,

soil type, natural vegetation and geological formation. Rajasthan has a heterogeneous assemblage of soil types and its geological formations have varied physical and chemical characteristics. Unless these parameters are scientifically determined, assessment results will not be of practical use. Even the classification of zones as "white", "gray" or "dark" may not depict the true picture.

Impact of Rainfall Variability on Water Resources

Rainfall is the most vital input in the hydrological cycle and fluctuations in quality and distribution strongly influence surface and sub-surface water sources. Often the impact of rainfall variability is clearly evident on surface water sources within a short time, but its impact on sub-surface sources is complex and long-lasting, often with a time lag between incidence and effect. Groundwater occurs under diverse climatic, physiographic and geological conditions and the sub surface medium through which water filters plays an important role in building-up groundwater reserves. A careful understanding of the terrain and recharge conditions and long-term studies on variations in rainfall

patterns and water exploitation are needed in order to interpret changes in groundwater storage. Table 9 shows the changes in water level over time by district. Because of the increased overdraft of groundwater from all the potential regions of western Rajasthan, recharge to the aquifer during normal rainfall periods is inadequate, especially because of the sporadic rainfall distribution patterns and the terrain characteristics, with a major portion of the precipitation being lost as runoff or through evaporation. It is therefore important to identify the potential aquifers so that the limited surplus rainwater received in the region is conserved efficiently for use during drought years and to meet the ever-increasing demands on underground water resources.

Impact of Drought

Apart from the periods of drought which limit recharge and lead to a lowering of the water table, the increase in number of wells and area irrigated also increase the rate of withdrawal of groundwater. The rate of withdrawal is greater than the recharge rate and leads not only to a decrease in the water level but also to a deterioration of the water quality. With this pattern of water use in various regions of the state, the impact of even a mild drought would have long-lasting effects on the water resources of the region. Prolonged droughts caused adverse effects experienced over all of Rajasthan during 1984–88 and 1997–2002. As a consequence of low rainfall and associated drought conditions, the groundwater reserves in most parts of the state were not sufficiently replenished. The groundwater level has dropped from 1 m to 6 m in about 90% of the state.

To assess the hydrogeological conditions of various aquifers, the Central Arid Zone Research Institute carried out a study on the water balance from 1977 to 1980. 42 key wells were selected at which rainfall and static water levels were recorded every day from June to March of the

Table 7 Rainfall variability in different regions of Rajasthan

Station	Normal rainfall (mm)	Average # of rainy days	Greatest annual rainfall (mm)	Greatest annual rainfall as a % of normal	Year of greatest rainfall	Greatest 24-hr rainfall (mm)	Date of greatest 24-hr rainfall
Arid							
Barmer	288.0	14.1	940.0	326	1944	285.7	13.8.1944
Bikaner	289.8	19.0	758.2	262	1917	165.6	25.9.1945
Churu	356.5	20.7	783.8	220	1917	146.1	5.9.1942
Ganganagar	248.4	19.5	674.0	271	1983	251.7	31.8.1928
Jaisalmer	186.2	12.5	583.1	313	1944	129.5	25.6.1961
Jalore	377.2	18.3	1039.4	276	1990	279.4	11.9.1905
Jhunjhunu	399.2	25.5	777.8	195	1956	121.9	14.7.1908
Jodhpur	365.2	20.0	1180.5	323	1917	215.9	12.9.1924
Nagaur	329.9	19.6	1259.0	382	1975	285.0	17.7.1975
Pali	418.3	19.0	1047.0	250	1990	200.0	6.8.1990
Sikar	455.8	29.7	1093.0	240	1977	184.4	25.8.1964
Semi-arid							
Ajmer	537.5	31.0	1226.8	228	1917	164.6	31.8.1928
Alwar	667.4	36.0	1260.3	189	1917	289.3	24.9.1904
Bharatpur	651.5	35.8	1382.8	212	1986	228.6	11.8.1916
Bhilwara	682.5	32.0	1304.0	191	1956	216.4	18.9.1950
Bundi	758.6	35.9	1546.6	204	1942	370.3	6.9.1947
Chittorgarh	862.9	33.5	1533.7	178	1944	274.3	20.7.1943
Dungarpur	738.0	36.8	1800.6	244	1937	486.4	30.6.1937
Jaipur	614.4	35.3	1317.0	214	1917	353.6	19.7.1981
Kota	760.9	37.9	1586.5	209	1917	249.2	13.7.1945
S. Madhopur	872.9	37.7	2445.0	280	1942	301.0	16.7.1942
Tonk	669.1	33.0	1513.6	226	1945	246.4	18.8.1945
Udaipur	640.1	34.4	1223.3	191	1917	183.9	18.9.1950
Sirohi	574.2	26.7	1571.6	273	1973	362.7	14.8.1941
Sub-humid							
Banswara	952.3	41.9	1977.0	210	1977	558.8	23.7.1957
Jhalawar	975.8	47.8	1708.2	175	1942	252.0	29.6.1945
Humid							
Mt. Abu	1593.8	52.9	3990.3	250	1944	484.9	14.8.1941

Source: Chatterji, P.C. (1993), 'Status of Ground Water in Rajasthan – Retrospect and Prospect', Institute of Development Studies, Volume II, pp. 321.

following year (Chatterji 1988). Similarly, a study of the water balance of the Luni Basin (32,805 km²) was carried out from 1979 to 1983 for which 141 key wells were selected and 250 rain gauging stations were set up. Such studies need to be conducted across the state on a continuous basis and the information generated used for managing the groundwater resource.

Groundwater Resource Assessment

All resources, whether non renewable or renewable, have their limitations for exploitation or use. This holds true for groundwater too. Although rain or surface water replenishes groundwater, the quantity of recharge is dependent on both natural and artificial parameters which vary across space. Spatially

sustainable use of groundwater requires equilibrium between all waters entering and leaving the basin. Determining the safe yield of a groundwater basin requires knowledge of;

- (i) the water supply available to the basin,
- (ii) the economics of pumping within the basin,
- (iii) the quality of the groundwater, and
- (iv) user rights in and around the basin.

Quantifying the groundwater available can be done using two concepts based on the existing hydrological situations:

- (i) the quantity concept for an unconfined aquifer, and
- (ii) the rate concept for confined aquifers. These are explained below.

Unconfined (Water Table) Aquifers

Groundwater is essentially a dynamic resource that is recharged by various sources. The most important mode of recharge to the aquifer is the direct infiltration of rainwater, which varies according to climate, topography, soil and sub-surface geological characteristics. Depending on the efficiency of the irrigation system and the soil characteristics, a portion of applied irrigation water also reaches the groundwater. Influent streams recharge the groundwater body too, depending on the drainage density, width of stream and texture of the riverbed material. Other sources of recharge include percolation from canal systems, reservoirs, tanks and other bodies of water. An estimation of these sources of recharge can give an estimate of safe yield.

Confined Aquifers

Confined aquifer resources can be quantified using the rate concept. In confined aquifers, water is released by decompression of the aquifer, unlike in an unconfined, water table aquifer where de-saturation takes place. The quality of groundwater transmitted through deeper zones can be computed and development of the resource be planned accordingly. For a scientific assessment of groundwater resources, the Ground Water Over Exploitation Committee was created in 1977 by the Agriculture Refinance and Development Corporation (ARDC), now known as the National Bank for Agriculture and Rural Development (NABARD). Following a detailed study, the committee made recommendations in 1979. Its methods used were later considered flawed, however, and in 1982 the Government of India created the Ground Water Estimation Committee. This committee, after consultation with various central and state organizations, universities, research and financial institutions, prepared a set of guidelines for assessing groundwater resources. A modified version of these guidelines is used by the SGWD today to calculate groundwater extraction and recharge (Vijay *et al.* 1986). Various organizations have suggested different methods for assessing groundwater potentials and rainfall

recharge. However, as Chatterji (1993) argues, adopting any of these methods requires knowing various natural parameters, such as the hydrological characteristics of geological and lithological formations, recharge through surface water resources, etc. Without knowing these parameters for a specific area, values have to be assumed. Chatterji pointed out shortcomings to the proposed methods and tried to develop a more accurate one for western Rajasthan based on detailed information of these parameters.

The major shortcomings Chatterji listed were:

- (i) The lack of information on rainfall in various terrains and their sub-surface characteristics, which require more rain gauge stations;
- (ii) That besides the area of the potential aquifer, the physiographic conditions of the area must be considered in order to estimate the groundwater resource;
- (iii) That water balances should be reported for drainage basin rather than district;
- (iv) That current observations of key wells - twice a year by the SGWD and four times a year by the Central Ground Water Board - seems inadequate given the state's geohydrological conditions. The number of observation days and the number of wells observed must be increased;
- (v) That currently, specific yield is used for estimating groundwater potential, but aquifer porosity would give better results;
- (vi) That more experiments need to be done on seepage and recharge through old tanks rather than using ad hoc estimations.

Augmentation of Groundwater Resources

Groundwater is a renewable, finite resource; annual recharge is governed by several natural factors. The stored capacity of groundwater

Table 8 Average number of rainy days in Rajasthan (1997–2001)

Name of Districts	1997	1998	1999	2000	2001
Jaipur/ Dausa	43	35	55	51	69
Tonk	-	-	27	26	29
Bharatpur	37	-	34	28	34
Alwar	44	-	31	26	36
Dholpur	36	-	31	28	36
Sikar	36	-	20	19	29
Jhunjhunu	41	35	24	22	27
Churu	34	27	15	13	22
Jodhpur	28	19	12	12	21
Jaisalmer	15	15	8	6	15
Barmer	22	17	11	22	15
Pali	32	21	16	16	24
Sirohi	32	28	16	21	31
Jalore	27	17	12	14	19
Udaipur/ Rajsamand	68	67	50	37	64
Banswara	Na	43	32	23	29
Dungarpur	39	39	27	32	30
Chittorgarh	37	33	32	24	29
Kota/Baran	96	-	72	51	68
Jhalawar	-	-	42	27	34
Sawai Madhopur/ Karauli	82	-	67	52	65
Bundi	38	36	28	26	27
Ajmer	31	20	16	17	24
Bhilwara	34	-	25	21	28
Nagaur	36	24	-	18	23
Bikaner	29	18	11	12	17
Ganganagar/ Hanumangarh	56	34	25	15	36
Average # of rainy days	35	26	24	20	28

Source: Ground Water Department, Jaipur

reservoirs combined with small flow rates provides a large, extensive distribution of water supply. In order to augment the natural groundwater reserve, artificial recharge of groundwater basins/bodies has been attempted. Artificial recharge can be defined as augmenting natural infiltration of precipitation or surface water into underground formations by altering natural conditions of replenishment. In other words, surplus water, which would otherwise flow out of an area, is retained for a longer period, thus enabling more infiltration than runoff. Artificial recharge is attempted in order to:

- i Restore supplies to an aquifer depleted from excessive draft or augment supplies to aquifers lacking adequate recharge;

- ii Store excess surface water underground for future use;
- iii Improve the quality of the groundwater or prevent its deterioration, or to create a fresh water layer;
- iv Remove sediment, bacteriological and other impurities from sewage and waste water effluent;
- v Store energy in aquifers or obtain cool water of a relatively constant temperature;
- vi Arrest or reduce land subsidence by increasing hydrostatic pressure.

Government Initiatives

The Department of Soil Conservation and the Department of Public Works are constructing artificial

recharge structures such as anicuts, bunds, khadins, raparts and percolation tanks and devising water spreading methods in order to reduce soil erosion and gulley formations, conserve soil moisture and provide causeways. These activities are being carried out in a sectoral approach. As a result, the effects of these activities on the groundwater regime are not known, mainly because these constructions were not designed with water resource exploitation in mind. Structure built in connection with artificial groundwater recharge or conjunctive utilization need to have certain pre-requisites, and hydrological and hydrogeological observations must be made over long periods after their construction to assess their effectiveness and benefits. The Ground Water Department initiated artificial recharge studies in 1990. The construction of recharge structures has been undertaken by the department with some reservation as there is no provision for comprehensive pre-feasibility or post-construction evaluation studies. The State Government's present effort in watershed development is a major intervention in natural resource regeneration and groundwater recharge. The budgetary allocation, which is the largest with any department, is given in Table 10. However, given the rainfall distribution pattern, the hydrogeological characteristics of the aquifer, the non-availability of silt-free surplus water at regular intervals and the variable quantities of water, it seems that adopting artificial recharge methods may not yield meaningful results to compensate for the overdraft. So far, very few scientifically designed experiments have been done to assess the suitability of various methods for different terrains, soils and rainfall zones. Their impacts on water resources and socio-economic development are therefore as yet unknown.

NGOs' Efforts in Groundwater Augmentation

People in the arid and semi-arid regions of Rajasthan practice

Table 9 Changes in pre-monsoon water levels, 1984–2001

District	Average rise/decline			Average annual rise/decline			
	1984–2001	1998–2001	1984–1998	1984–2001	1984–1998	1998–2001	2001
Ajmer	-6.29	-5.59	-0.7	-0.37	-0.05	-1.86	-0.7
Alwar	-6.72	-4.2	-2.52	-0.4	-0.18	-1.4	-1.79
Banswara	-1.66	-2.22	-0.556	-0.1	-0.04	-0.74	-1.63
Baran	-2.83	-3.01	0.18	-0.17	-0.01	-1.03	-2.06
Barmer	-1.8	-1.51	-0.29	-0.11	-0.02	-0.5	-0.48
Bharatpur	-2.66	-1.97	-0.69	-0.16	-0.05	-0.66	-1.6
Bhilwara	-6.19	-5.11	-1.08	-0.36	-0.08	-1.7	-1.4
Bikaner	1.74	1.29	1.45	0.1	-0.1	0.1	-0.2
Bundi	-5.04	-4.5	-0.54	-0.3	-0.04	-1.5	-1.35
Chittorgarh	-5.58	-3.02	-2.56	-0.33	-0.18	-1.01	-1.23
Churu	0.09	-0.53	-0.62	0.005	-0.04	-0.18	0
Dausa	-4.46	-2.99	-1.47	-0.26	-0.11	-1	-1.75
Dholpur	-2.72	-1.43	-1.29	-0.16	-0.09	-0.48	-0.87
Dungarpur	-3.75	-3.5	0.15	-0.22	-0.01	-1.3	-1.7
Hanumangarh	-	-	-	-	-	-	-
Sri Ganganagar	-	-	-	-	-	-	-
Jaipur	-6.68	-2.33	-4.35	-0.39	-0.31	-0.8	-1.15
Jaisalmer	0.27	-0.33	0.6	0.015	-0.04	-0.11	-0.09
Jalore	-8.66	-3.94	-4.22	-0.51	-0.34	-1.31	-0.77
Jhalawar	-2.42	-3.54	1.12	-0.14	-0.08	-1.18	-1.34
Jhunjhunu	-7.67	-3.9	-3.77	-0.45	-0.27	-1.3	-1.21
Jodhpur	-7.57	-3.3	-4.47	-0.45	-0.32	-1.1	-1.02
Karauli	-4.65	-1.83	-2.82	-0.27	-0.2	-0.28	-1.79
Kota	-2.87	-3.46	0.62	-0.17	-0.04	-1.15	-2.72
Nagaur	-7.07	-2.63	-4.44	-0.42	-0.32	-0.88	-1.08
Pali	-7.19	-6.25	-0.94	-0.42	-0.07	-2.08	-1.47
Rajsamand	-5.95	-5.06	-0.89	-0.35	-0.43	-1.69	-1.12
Sawai Madhopur	-3.8	-2.82	-0.98	-0.22	-0.27	-0.94	-2.31
Sikar	-5.72	-2.58	-3.14	-0.34	-0.41	-0.86	-0.72
Sirohi	-6.69	-5.56	-1.13	-0.39	-0.48	-1.85	-0.88
Tonk	-5.6	-3.99	-1.61	-0.33	-0.4	-1.33	-1.98
Udaipur	-3.3	-3	-0.8	-0.23	-0.27	-1	-1.03

innovative methods of harvesting rainfall runoff for drinking and agriculture by building embankments. Several NGO's have initiated programs aimed at reviving these traditional water harvesting systems with community participation. Some popular NGO's are Tarun Bharat Sangh, Gramin Vikas Vigyan Samiti (GRAVIS), Social Work Research Centre (SWRC), Center for Community Economics and Development Consultants Society (CECOEDECON), Seva Mandir and Pradhan. They focus on watershed management, natural resource management, drought mitigation, improving drinking water supply, soil conservation, etc. A range of activities was undertaken to harness rainwater runoff. The structures range from earthen field bunds to cement concrete structures, and from plugging water flow in small streams to structures to harness the flow from whole watersheds

or sub-river basins. Funding varies from government to international rural-support organizations. With all these interventions, the main objective was to check surface runoff, impound water and recharge groundwater. Most of the NGOs' activities are participatory and address immediate local needs, but little consideration is given to impacts downstream and at the watershed scale. The design and location of the structures are guided by local conditions, especially the topography of the area, and built with traditional and/or modern knowledge. These NGO interventions are so varied and location-specific that in most cases it is difficult to replicate, either because of geographical conditions or the prevailing socio-economic and political conditions. Even when models are followed, as in the case of watershed development, their implementation varies across the State. However, one

Table 10 Watershed development in Rajasthan – physical and financial achievements between 1974 and 2002

Year	NWDP*		Special Plans		Outsider Helping Plans		Total	
	Area (ha)	Rs. ('000)	Area (ha)	Rs. ('000)	Area (ha)	Rs. ('000)	Area (ha)	Rs. ('000)
1974–75	—	—	59681	6.27	—	—	59681	6.27
1975–76	—	—	54582	48.58	—	—	54582	48.58
1976–77	—	—	18248	0.7	—	—	18248	0.7
1977–78	—	—	8299	6.72	—	—	8299	6.72
1978–79	—	—	16303	67.3	—	—	16303	67.3
1979–80	—	—	35649	92.76	—	—	35649	92.76
1980–81	—	—	32356	236.31	—	—	32356	236.31
1981–82	—	—	46530	219.45	—	—	46530	219.45
1982–83	—	—	41840	315.66	—	—	41840	315.66
1983–84	—	—	36086	375.08	—	—	36086	375.08
1984–85	—	—	17368	124.28	—	—	17368	124.28
1985–86	—	—	29677	581.08	—	—	29677	581.08
1986–87	1329	8.43	66249	1669.07	—	—	67578	1677.50
1987–88	11597	90.77	30870	877.8	—	—	42467	968.57
1988–89	9645	90.20	26638	1023.56	—	—	36183	1113.76
1989–90	11763	120.99	31460	1091.35	—	—	43223	1212.34
1990–91	9000	833.64	24057	1420.74	—	71	33057	2325.38
1991–92	24633	750.82	22485	1110.16	1407	365.12	48525	2226.10
1992–93	95555	1464.01	28281	1378.83	5431	872.07	129267	3714.91
1993–94	104882	2086.87	46942	1284.98	14146	1271.89	165970	4643.74
1994–95	77879	2452.00	38581	2430.69	25568	1397.99	142028	6280.68
1995–96	96087	3500.50	97468	2360.52	25614	2515.68	219169	8376.70
1996–97	116015	3548.27	36355	1183.66	29700	2906.41	182070	7638.34
1997–98	75950	2578.7	26459	2667.15	36105	2400.15	138514	7646.00
1998–99	89459	3814.49	79872	4080.24	13500	1473.79	182831	9368.52
1999–00	85792	3932.71	69910	4262.27	1102	182.34	156804	8377.32
2000–01	119518	3895.82	51463	5748.89	247	82.09	171228	9726.80
2001–02	60783	3654.88	25576	4323.66	—	—	86359	7978.54
Total	989887	32823.10	1099285	38987.76	152820	13538.53	2241992	85349.39

Source: Watershed Rajasthan Annual Report 2001–2002, pp. 16–17.

*National Watershed Development Programme

common element in all these interventions is groundwater recharge. As groundwater recharge depends on geohydrological parameters, it becomes difficult to assess their actual impact. This becomes even more difficult when the intervening agency is not aware of these technical parameters. What is known, from the existing literature and field visits, is that NGOs are good at mobilizing and motivating communities for such works, economizing on costs and ensuring, to a degree, the utilization and sustainability of the system. But the NGOs do not know the exact nature of the benefits derived from these recharge structures.

Even when they attempt to evaluate their benefits, they invariably either ignore or give a low priority to the technical parameters. It is not that NGOs are not interested in such evaluations, but they lack the necessary information and expertise to do so with any accuracy.

Technical Review of Recharge Impact Reports

The technical review presented here summarizes all the technical evaluations of water harvesting and groundwater recharge activities that the Institute of Development Studies in Jaipur was able to identify through an

extensive literature search. Before going into detail, however, it is important to emphasize that, while the published literature on water harvesting and groundwater recharge in Rajasthan is huge, very little of it contains any technical information.

Despite the scale of emerging groundwater overdraft problems and the large amounts of time and money invested in addressing the problem, and despite extensive reviews of available literature, the Institute of Development Studies in Jaipur was only able to locate three semi-technical analyses that address the impacts that water harvesting and groundwater recharge activities may be having. These technical analyses were each undertaken by the International Water Management Institute, the Government of Rajasthan, and by Dr. Agrawal from IIT Kanpur (Agrawal 1996; H.D.D. Directorate 1999; Bagider, Sakthivadivel *et al.* 2002).

The first of these studies, by the IWMI team, focused on the 'Paal' system of water harnessing in Alwar district of Rajasthan. In their study, they documented the benefits of water harvesting as an increase in the water table and in agriculture production by participating households. The second study, by Agarwal (1996), pertains to the large number of traditional rainwater harnessing structures called 'Johads' that were revived and constructed by Tarun Bharat Sangh in Alwar district. The third study was done by the Irrigation Department, Government of Rajasthan, to investigate the impact of Johads on the Sainthal Sagar Dam1. The information and limitations of these three analyses is summarized here. This is not intended to be an evaluation of the impact of the water harvesting activities themselves but rather an evaluation and summary of the technical information contained in these reports.

General Approach of Existing Evaluations

Before discussing the

individual reports, two points are important to recognize with regard to the information they contain. *First*, the analyses are largely empirical; they report observed relationships between recharge activities, groundwater levels, stream flows, etc. As far as can be determined, no attempts were made to estimate key hydrological parameters or model hydrologic dynamics in the reports. *Second*, the reports contain little baseline data and relatively little indication of the sources for the data they do use. As a result, it is impossible to cross check the accuracy of the relationships they report in most cases.

Overall Conclusions and Recommendations

One of the largest challenges in evaluating the viability of groundwater harvesting for recharge is the lack of accessible technical information on the overall groundwater context in Rajasthan. As a result, the first step in planning and the development of groundwater resources in the State should be detailed mapping of the resource base. In addition, to assess and plan optimum utilization of groundwater resources, precise determination of all the hydrological parameters under different geomorphic and rainfall conditions for the same lithological unit is required. Even the river basin boundaries should be demarcated more precisely – something that can be achieved with the help of advanced remote sensing techniques.

In areas where basin boundaries cannot be identified, we suggest that the area of the basin be classified into "Donor" and "Receptor" zones or as "Index Catchment". Assessment and exploitation of groundwater resources should be restricted to Receptor Zones only in order to derive maximum benefit of the recharge, whether natural or artificial. Geomorphic mapping of the State on a 1:50,000 scale depicting all structural controls such as lineaments, present and prior drainages, flood and alluvial plains, existing wells/tubewells, donor and receptor zones for the areas covered with sand and sand dunes having no defined drainage system,

groundwater potential basins, etc. will provide a better understanding for further exploration, exploitation and correlation of results in order to better manage the groundwater resources.

It is of paramount importance to understand the interrelationship between the drainage pattern and lithological formations and the groundwater potential and recharge. To better understand rainfall patterns, the World Meteorological Organization has suggested that rain gauging stations be installed on a 10-km grid in the plains and a 5-km grid in hilly areas of arid and semi-arid regions. Though unproductive areas do not directly contribute to the groundwater resources of the state, they do contribute to generating surface runoff and/or subsurface flow to the potential aquifer. In Rajasthan, the India Meteorological Department has 30 observatories, the Revenue Department has 268 rain gauging stations, the Irrigation Department has 223 rain gauging stations and the Central Water Commission has 14 rain gauging stations - a total of 535 rain gauging stations already exist in the state. Besides these, there are many rain gauging mechanisms installed on Dak Bungalows and Circuit Houses under the control of the Public Works Department. If an observation well is within one or two kilometers of one of these rain gauging stations, the data being generated by them should be used to assess groundwater changes.

The Ground Water Department has identified 583 groundwater potential zones in 26 districts of Rajasthan. Although Rajasthan already has one of the largest state networks of piezometers and key wells where groundwater levels are monitored, the links between these wells and other hydrologic parameters are often unclear. We believe it would be desirable to have one monitoring station consisting of one key well and one rain gauging station in each zone for regular observations. In larger zones, more monitoring stations need to be selected.

However, for a better understanding of the behavior of variation in water level in the more

heterogeneous groundwater potential zones, two wells per rain gauging station would give better results. The Ground Water Department is already monitoring 6,708 key wells and the Central Ground Water Board is monitoring 1,095 key wells. As far as possible, existing key wells should be used for establishing monitoring stations. Monitoring procedures for both groundwater and rainfall must be coordinated to evaluate the relationship between precipitation and recharge. This can be achieved by establishing a proper rain gauging station network, as suggested by the WMO, and linking it with piezometers that are equipped with data loggers to frequently record groundwater level changes. This will allow for an evaluation of rainfall intensity-duration relationships and the time lag between rain spells and any recharge generated.

The ionic composition of groundwater in relation to the mineralogical assemblage and weathered products of aquifers as well as the changing patterns and behaviors of various ions in the groundwater needs to be investigated and analyzed to monitor water quality. So far, no such information is available. Because the intensity and duration of rainfall plays a vital role in the generation of recharge, it is suggested that 10% of the monitoring stations be equipped with self-recording rain gauges and water level recorders. These could be installed in colleges, higher secondary schools, tehsils, Block Development Officer (BDO) headquarters or other government offices where responsible people are available to handle the equipment.

At other monitoring stations, water level is to be recorded before the exploitation of an aquifer starts and rainfall is to be recorded according to standard practice at 8.00 every morning during the monsoon period. Feasibility studies on groundwater recharge techniques, their relative merits and economics under different terrain, rainfall and socio-economic conditions are essential. This would help in standardizing more suitable artificial recharge methods for Rajasthan. ■

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KNOW ABOUT WATER



Q. What is Water ?

- Water is life. You can live without food for more than a month, but cannot only live without water for more than a week. In some organisms, (like jellyfish!) up to 90 % of their body weight comes from water. In human body, nearly 60 % is water - brain is composed of 85 % water, blood is 79 % water and the lungs are nearly 80 % water.

Q. How much water is on earth?

- Water covers nearly 75 % of the earth's surface. But 97 % of it is in the oceans and only 3 % of the earth's water can be used as drinking water. However, major part of it is either frozen in the polar ice caps or locked up in soil. Thus the water that can be utilized by us is only 0.5% of

total water on the earth's surface.

The total water supply of planet earth is 1335 million cubic km. It simply means that if we can construct a cubic box of length, breadth and height of 1 km each, we will require 1335000000 such boxes to store all the water. Amazing! Isn't it?

About 13000 cubic km of water, mostly in the form of water vapor, is in the atmosphere at any one time. If it all fell at once, the Earth would be covered with only about 25 mm of water. Each day, 1150 cubic km of water evaporate or transpire into the atmosphere of the freshwater on earth, much more is stored in the ground than is available in lakes and rivers. More than 8,000,000 cubic km of fresh water is stored in the earth in comparison to about 150,000 cubic km of water stored

in lakes, inland seas and rivers. Most of groundwater is within a km of the earth's surface.

About 18,000,000 cubic km of water found in glaciers and icecaps, mainly in the polar regions and in Greenland

Q. Why is the Ocean Salty?

-The rain that falls on the land becomes slightly acidic due to some dissolved carbon dioxide from the surrounding air. The acid erodes and breakdowns the rock on earth and carries it along in a dissolved state as ions. The ions are carried through the streams and rivers to the ocean. While many of the dissolved ions are used by organisms others are left for long periods of time where their concentrations increase over time. The seawater contains chloride and sodium which make up over 90 % of all dissolved ions in seawater. The seawater contains nearly 3.5 % of dissolved salts. This makes the ocean water salty.

Q. What is water cycle ?

-One special characteristic of water is its ability to change state very easily. It can be found readily on the planet in all of its three forms, solid, liquid, and gas. The earth also has a limited amount of water. That water keeps going around and around, changing its states, in what we call the "Water Cycle" or the hydrologic cycle. The hydrologic cycle takes place in the hydrosphere, a region containing all the water in the atmosphere and on the surface of the earth. The cycle is the movement of water through this hydrosphere. Now the entire process is very simple, divided into six parts as shown in the picture

Condensation occurs when water vapor condenses in the atmosphere to form clouds. When the air cools enough, water vapor condenses on particles in the air to form clouds. As clouds form, winds move them across the globe, spreading out the water vapor. When eventually the clouds can't hold the moisture, they release it in the form of precipitation, which can be snow, rain, hail, etc.

The next three stages: infiltration, runoff, and evaporation

occur simultaneously. Infiltration occurs when precipitation seeps into the ground. If precipitation occurs faster than it can infiltrate the ground, it becomes runoff. Runoff remains on the surface and flows into streams, rivers, and eventually large bodies such as lakes or the ocean. Infiltrated groundwater moves similarly as it recharges rivers and heads towards large bodies of water. Evaporation is the change of liquid water to a vapor through heat of the sun. Sunlight heats the liquid water in oceans and lakes and change into a gas. Warm air rises up into the atmosphere and becomes the vapor involved in condensation.

The hydrologic cycle continues to move water and keep sources fresh. Without this process life on Earth would be impossible.

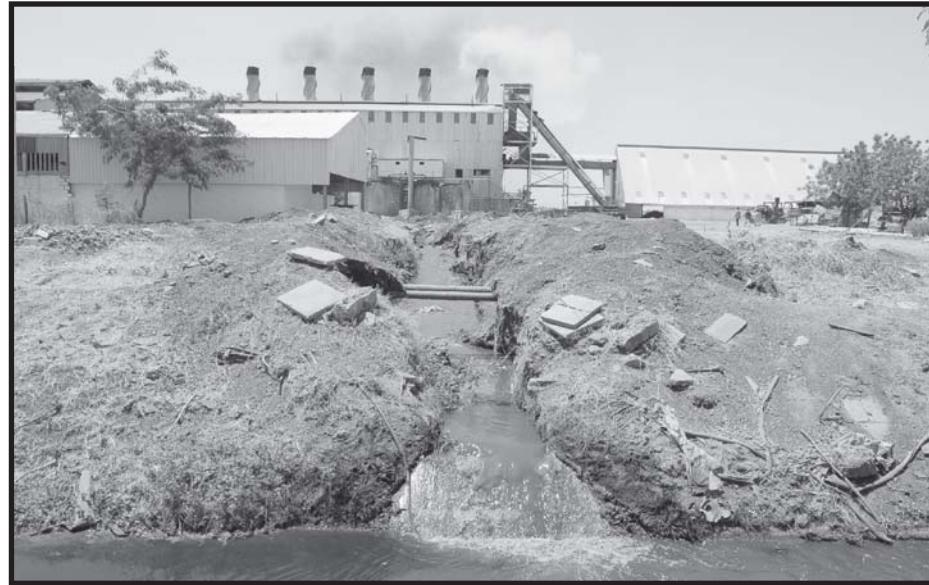
Q. What is water pollution?

-When toxic substances enter lakes, streams, rivers, oceans, and other water bodies, they get dissolved or lie suspended in water or get deposited on the bed. This results in the pollution of water whereby the quality of the water deteriorates, affecting aquatic ecosystems. Pollutants can also seep down and affect the groundwater deposits. The main sources of water pollution are:

- ❖ Domestic sewage like wastewater and sanitary sewage that is discarded from households.
- ❖ Agricultural Run off like ground water from agricultural fields where chemical fertilizers have been used indiscriminately.
- ❖ Industrial Effluents like Wastewater from manufacturing or chemical processes in industries .

Q. Effects of Water Pollution

-Water pollution is not only affect the people but also to animals, fish, and birds. Polluted water is unsuitable for drinking, recreation, agriculture, and industry. It diminishes the aesthetic quality of lakes and rivers. Contaminated water destroys aquatic life and reduces its reproductive ability.



Q. Health impacts of water pollution

-Water-borne diseases are infectious diseases spread primarily through contaminated water. Hepatitis, cholera, dysentery, and typhoid are the more common water-borne diseases that affect large populations in the tropical regions. Exposure to polluted water can cause diarrhea, skin irritation, respiratory problems, and other diseases, depending on the pollutant that is in the water body. Stagnant water and other untreated water provide a habitat for the mosquito and a host of other parasites and insects that cause a large number of diseases especially in the tropical regions.

Q. Water Conservation

-Over the years rising population, growing industrialization and expanding agriculture have pushed up the demand for water. So conservation of water has become the need of the day. Rainwater harvesting essentially means collecting rainwater on the roofs of building and storing it underground for later use. It is essential to improve groundwater decline and groundwater levels, arrest seawater ingress, i.e. prevent the sea from moving further land ward, and conserve surface water run-off during the rainy season and urban wastewater.

What can you do to conserve water?

- ❖ Verify that your home is leak-free.

- ❖ Use only as much water as you require.
- ❖ Close the taps well after use.
- ❖ While brushing your teeth do not leave the tap running, open it only when you require it.
- ❖ Take a short shower instead of a bath.
- ❖ Use a washing machine that does not consume too much water.
- ❖ Do not leave the taps running while washing dishes and clothes.
- ❖ Never put water down the drain when there may be another use for it such as watering a plant or garden, or cleaning.
- ❖ Water in which the vegetables and fruits have been washed can be used to water the flowers and ornamental potted plants.
- ❖ At the end of the day if you have water left in your water bottle do not throw it away, pour it over some plants
- ❖ Don't leave a water hose running.
- ❖ Don't throw trash in ponds, rivers or the ocean.

■ ***(Compiled by : Sanjay Saxena)**



VASUNDHARA RAJE
Chief Minister, Rajasthan



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GROUNDWATER IN RAJASTHAN

SCENARIO, PROBLEMS AND REMEDIAL MEASURES

■ L.N. Mathur



L.N. Mathur

With rapid increase in population and water demand, Rajasthan State is heading towards absolute water scarcity. Owing to the enhanced aridity, surface water

availability is scarce (low rainfall along with higher rate of evaporation/evapotranspiration losses) and is less dependable (erratic rains in time and space).

Low soil moisture, lack of perennial rivers/no drainage in major Thar desert area further deteriorates the situation. Frequent incidence of meteorological/agriculture drought spells (due to geographic location) makes the situation still worst. Groundwater levels in larger parts of Western Rajasthan are deep and saline. Since green revolution, intensive groundwater based irrigation practices have developed depleting trend of resources causing groundwater drought

situation in the larger parts of the State. Development of no water scenario (both surface and groundwater) in the decades to come will be the most serious issue of concern for the future generations in the State. Low storage capacity in hard rock areas, deep groundwater levels (due to deep basement & less recharge to groundwater) and limited availability of fresh groundwater resources (inferior quality due to high salinity and fluoride contents because of enhanced aridity) are natural causes of freshwater deficiency in the State. Anthropogenic reasons include diminishing groundwater resources thereby declining trend in groundwater levels (over-exploitation of resources), water logging in canal command areas and industrial pollution etc. and are the main water related issues developing acute freshwater crisis situation in the State due to human interventions.

Effective and efficient water management options need to incorporate both structural & nonstructural measures including water conservation, augmentation of this natural resource (especially groundwater assets by artificial recharge techniques). The regulatory steps (non

structural measures) may include generating awareness among common people, imparting training, human resource development at school & college levels, encouraging innovative scientific approach (R & D work), development of groundwater sanctuaries, notification of vulnerable areas by Central Ground Water Authority, formulation & effective enforcement of water policies & groundwater Act etc. Integrated participatory management approach involving representatives from Central & State Government organizations, NGO's, industrialists, academic & research institutions at State, WUA at District and Panchayat levels may be the key to successful enforcement of the proposed management strategies.

Introduction

Life on our planet earth is due to water. Demands of water for domestic, irrigation as well as industrial sectors have increased many folds creating water crisis worldwide. Next world war will be for water. Conflicts will be there from street level to International levels.

An arid land of Rajasthan is the most water deficit part on the earth. The largest State of India is also the driest State having only 1.15% of total water resources of the entire country. Catering safe drinking water to over 5.65 crores population is a big task before scientists, engineers, administrators and policy planners. Availability of surface water is mainly restricted to canal command areas of India Gandhi Nahar (IGNP), Chambal and Mahi rivers. Groundwater is the dependable source in the larger area of the State. Depleting precious groundwater resources and its inferior quality limits the availability of freshwater assets. Drought stays here as unwanted guest almost every year. Water crisis is of acute nature and needs immediate attention of the water managers.

Aravali hill range serves as major water divide separating western



Thar Desert and eastern Rajasthan. The State occupies a wide spectrum of geomorphic features of Aravalli hill range, Eastern plains, Vindhyan scarpland - Deccan plateau and western Thar Desert. Thar desert area is again divided in to Arid Thar desert (Marushtali), Semiarid Transitional Zone and Ghaggar floodplain area. Luni river is the only integrated ephemeral river system in western Rajasthan whereas eastern Rajasthan is drained by the Chambal, Yamuna - Ganga, Mahi (perennial) and ephemeral rivers of Banganga, Barah, Sota, Sahibi, Sabarmati, Banas etc. Indira Gandhi Nahar, Bhakra and Gang canal have been constructed to bring Himalayan water to the Marubhumi so as to create irrigation facilities and drinking purposes. However, lack of conjunctive use of surface and groundwater has given birth to water logging hazards. Rajasthan is known for its arid climatic conditions (particularly western parts) and is characterized by low, erratic and unevenly distributed rains causing frequent meteorological, hydrological and agricultural droughts.

Ground Water Scenario

The State is occupied by diversified geo-formations and hydro-geological conditions. Groundwater occurs in unconsolidated formations (Quaternaries), semi-consolidated formations (Tertiary sandstone, Lathi sandstone etc.) and consolidated rock types. Quaternary alluvium, Lathi sandstone, Palana sandstone, Borunda limestone and Jodhpur sandstone at places are some of the prominent aquifer systems available in the State and are heavily over-exploited. Water level is deeper in western Rajasthan reaching even more than 130 m as in Lathi basin area. Depth to water level is relatively shallower in eastern Rajasthan. Rising trends in groundwater levels have been observed in parts of IGNP canal command areas. Major parts of the State witness rapidly declining water levels. Severe water level declining districts include Jaipur, Sikar, Jhunjhunu, Nagaur, Jodhpur, Jalore,

Increasing rate of Water level decline in time and space									
S.N	Block	Average WL 1984 (m)	Average WL 1996 (m)	Average WL 2001 (m)	Average WL 2006 (m)	WL Fluctuation Pre-Post 2006	Rate of WL decline 84-06 (m/yr)	Rate of WL decline 96-06 (m/yr)	Rate of WL decline 01-06 (m/yr)
1	Amer	16.90	18.54	21.53	32.51	-0.90	0.71	1.4	2.20
2	Bairath	11.79	15.68	16.45	23.65	-0.98	0.54	0.8	1.44
3	Bassi	11.39	18.80	27.79	29.45	-0.41	0.82	1.07	0.33
4	Chaksu	9.62	11.85	13.58	22.73	1.60	0.60	1.09	1.83
5	Dudu	10.35	13.97	15.87	19.98	-0.98	0.44	0.60	0.82
6	Govindgarh	10.75	16.74	20.84	30.41	-0.15	0.89	1.37	1.91
7	J.Ramgarh	12.12	20.09	21.77	24.58	0.93	0.57	0.45	0.56
8	Jhotwara	13.81	24.86	28.82	41.25	-0.83	1.24	1.64	2.49
9	Kotputli	10.05	15.91	18.24	21.79	-0.55	0.53	0.59	0.71
10	Phagi	10.03	12.17	13.03	17.40	0.21	0.33	0.52	0.87
11	Sambhar	11.21	18.41	21.74	33.51	1.72	1.01	1.51	2.35
12	Sanganer	14.58	23.45	28.30	36.88	2.24	1.01	1.34	1.72
13	Shahpura	16.80	24.63	28.56	31.10	-0.70	0.65	0.65	0.51

Pali, Dausa & Barmer.

Quality of Ground Water

Chemical quality of aquifer water in the W. Rajasthan, in general, and Bharatpur, Ajmer and Jaipur districts in the eastern Rajasthan, in parts, are saline. High fluoride hazard is found in pockets in almost all the districts of the State causing disease called fluorosis. However, situation in Nagaur, Tonk, Sirohi, Jaipur, Jhunjhunu, Churu, Bikaner, Jalore and Jodhpur is worst where more than 50 % area is having fluoride concentration above 1.5 mg/l. Increased use of

Causes of water scarcity

(i) Low Rainfall - Arid Climates

The geographical location of the State has caused arid/semiarid climatic conditions in Rajasthan. Rainfall is low and erratic. Southwesterly monsoon clouds are mostly moistureless especially in Thar desert. Surface water is under high evapotranspiration losses. Groundwater recharge is negligible in the western most parts of Rajasthan, where not only rains are scarce but also ground water level is usually deep. Soil moisture is generally very low due to

Saline water and canal command areas.

Net annual ground water availability	-10382 mcm.
Gross annual ground water draft	- 12991 mcm
Ground water balance	- (-) 2609 mcm
Stage of ground water development	- 125 %
Water and requirement for domestic and industrial sectors as on 2025	- 2720 mcm

Ground Water Resource Availability (as on 31.03.2004)

"Increasing demand of water for various sectors have brought 140 blocks under over-exploited and 50 blocks as critical category leaving behind only 14 semi-critical and 32 safe blocks mainly in saline water and canal command areas."

fertilizers and poor sewerage system in the urban agglomerate has caused high nitrates in aquifer water as is observed in Jaipur city area. Industrial and urban pollution has further caused deterioration in the quality of groundwater. High soil and water salinity in the water logged areas within canal command areas have been developed causing land degradation. However, a freshwater layer over saline water has been developed in the immediate vicinity of IGNP canal command areas, which need to develop system of conjunctive use of surface and groundwater resources.

aridity. No major drainage system exists in major parts of the Thar desert. Owing to aridity and geo-formations, groundwater is saline and salt lakes have been developed.

(ii) Frequent Drought Conditions

Low and uneven distribution of monsoon rains in Rajasthan causes frequent meteorological and/or agriculture droughts in time and space as witnessed especially during 1972-74, 1984-87 and 1998-2002. Western districts (parts of Thar desert) are more prone to severe and most severe type of

droughts and have been categorized as chronically Drought Prone Districts. Frequent droughts not only have socio-economic impact but also have adverse environment impacts. Drought situation accelerates sinking of additional groundwater abstraction structures causing diminishing of groundwater resources and eventually decline in ground water levels. Water crisis is on its peak during these spells of drought years affecting millions of human population as well as livestock forcing them to migrate in the adjoining States. State has to divert millions of rupees all most every year for drought mitigation

leaving behind no money for water sector developments (artificial recharge to groundwater etc.)

(iii) Less availability of freshwater

Chemical quality of groundwater in the western Rajasthan, in general, and Bharatpur, Ajmer and Jaipur districts in parts in the eastern Rajasthan saline; genesis of which include arid climate, geo-formations, inland drainage systems, clogging of the palaeochannels and water logging in canal command areas etc. Aridity & semi-arid climates, over pumping and other set of favorable physio-chemical

conditions have also generated high fluoride hazard (in pockets) in almost all the districts of the State causing disease called fluorosis. Increased use of fertilizers and poor sewerage system along with poor solid waste disposal systems in the urban agglomerate has caused high nitrates in aquifer water. Industrial and urban pollution have further caused deterioration in the quality of ground water resources. Over-application of canal water (flood irrigation) and also the water logging within Canal Command Area has also caused soil salinity/alkalinity and contributed to salinity in groundwater.

(iv) Deep and Declining Water Levels

Deep water levels especially in the western Rajasthan is primarily due to deeper basement (geo-synclinal deposits) and negligible natural recharge to groundwater due to less rains & high evaporation. Deeper groundwater levels (reaching up to 130m) do not allow economic pumping of water for irrigation and other purposes. Increasing draft in major areas is causing lowering of ground water levels significantly resulting in high cost of pumping/well construction.

(v) Hard rock area

Hard rocks have poor storage capacity of groundwater and therefore witness steep decline in groundwater levels during summers especially during spells of drought years. Most of the wells, hand pumps and tube wells get dried up during prolonged droughts in hard rock areas. These areas are therefore under most water crisis and even drinking water is catered by transportation from far off locations by trucks and trains.

(vi) Dispersed Population

Population in the desert terrain is dispersed in helmets spreading over several kilometers and therefore a challenging task to cater water supply of standard quality economically.

(vii) Undependable Energy Supply

Inadequate quality electricity

Ground Water Resources as on 31.03.2007												
Block	Area of Block (Sq.Km.)	Type of Area	Potential Zone	Potential Zone Area (Sq.Km.)	Net Annual Ground Water Availability (mmcm)	Existing Gross Ground Water (mmcm)	Existing Gross Draft for Irrig. Use (mmcm)	Existing Ground Water Draft for Water Use (mmcm)	Allocation for Dom. & Indus. for All Uses (mmcm)	Stage of Ground Water Development (%)	Category	
Amer	898.64	NC	A	746.46	57.1690	99.3551	8.2307	107.5858	20.2160	188.19		
		NC	Q	104.02	5.7584	6.6073	6.0867	12.6940	7.8253	220.45		
Block Total				850.48	62.9273	105.9624	14.3175	120.2799	28.0413	191.14	O.E.	
Bairath	706.10	NC	A	588.38	43.3962	34.5655	8.8122	43.3776	9.2748	99.96		
		NC	Q	75.60	2.7601	3.2436	1.6032	4.8468	3.8263	175.60		
Block Total				663.98	46.1563	37.8091	10.4154	48.2245	13.1011	104.48	O.E.	
Bassi	654.69	NC	A	218.85	14.1655	17.0586	6.0604	23.1190	12.2500	163.21		
		NC	Ao	357.62	25.1501	47.5332	3.3995	50.9327	8.0560	202.51		
		NC	Q	54.76	1.5385	3.4073	1.0445	4.4518	2.4763	289.35		
Block Total				631.23	40.8542	67.9991	10.5044	78.5035	22.7823	192.16	O.E.	
Chaksu	811.92	NC	Ao	552.06	35.2286	54.4657	2.7771	57.2428	7.8200	162.49		
		NC	Sc	177.30	5.9030	9.5722	1.5790	11.1511	2.6010	188.90		
Block Total				729.36	41.1316	64.0379	4.3561	68.3939	10.4210	166.28	O.E.	
Dudu	1870.64	NC	Ao	327.26	18.2569	18.5569	4.1236	22.6805	5.9062	124.23		
		NC	Sc	407.93	18.3264	8.3038	2.4667	10.7705	3.7700	58.77		
		NC	Gn	1055.68	26.4321	17.6310	7.9719	25.6029	11.5600	96.86		
Block Total				1790.87	63.0154	44.4917	14.5622	59.0539	21.2362	93.71	Critical	
Govindgarh	685.12	NC	A	638.08	50.9257	114.9540	10.9342	125.8882	19.1600	247.20		
Block Total				638.08	50.9257	114.9540	10.9342	125.8882	19.1600	247.20	O.E.	
J.Ramgarh	1033.70	NC	A	577.82	34.8713	46.3735	3.2856	49.6591	4.4000	142.41		
		NC	Q1	96.85	3.2801	5.7069	0.7225	6.4294	0.7400	196.01		
		NC	Q2	78.95	2.6536	4.5013	0.2870	4.7883	0.5900	180.45		
		NC	Sc	136.01	3.9195	2.9254	0.6855	3.6109	1.0200	92.13		
		NC	G	72.25	1.8154	1.5600	0.2343	1.7943	0.5900	98.84		
Block Total				961.88	46.5399	61.0671	5.2150	66.2821	7.3400	142.42	O.E.	
Jhotwara	568.79	NC	A	553.04	49.9523	70.9970	94.3808	165.3778	191.5900	331.07		
Block Total				553.04	49.9523	70.9970	94.3808	165.3778	191.5900	331.07	O.E.	
Kotputli	691.71	NC	A	442.21	47.8028	75.7416	8.0493	83.7909	13.1300	175.28		
		NC	Q	130.54	4.3910	5.6794	1.0918	6.7712	1.9700	154.21		
Block Total				572.75	52.1938	81.4210	9.1411	90.5621	15.1000	173.51	O.E.	
Phagi	1114.34	NC	Ao	396.11	32.3141	25.9032	2.4005	28.3037	2.4100	87.59		
		NC	Sc	73.40	1.9547	1.8727	0.3978	2.2705	0.4200	116.15		
		NC	Gn	304.00	8.0944	7.7449	0.3771	8.1220	1.8900	100.34		
Block Total				773.51	42.3632	35.5208	3.1754	38.6962	4.7200	91.34	Critical	
Sambher	938.40	NC	A	249.44	19.3761	41.7639	4.1962	45.9601	5.9065	237.20		
		NC	Ao	582.04	25.0082	66.9467	6.1455	73.0922	14.6768	292.27		
Block Total				831.48	44.3843	108.710	10.3418	119.0524	20.5833	268.23	O.E.	
Sanganer	657.54	NC	Ao	613.87	41.1202	78.7514	21.1881	99.9395	36.3315	243.04		
Block Total				613.87	41.1202	78.7514	21.1881	99.9395	36.3315	243.04	O.E.	
Shahpura	429.85	NC	A	384.14	27.6890	48.2402	8.3627	56.6029	19.8833	204.42		
Block Total				384.14	27.6890	48.2402	8.3627	56.6029	19.8833	204.42	O.E.	
Phagi		Saline	Ao(S)	340.06	19.4435	15.6521	0.0000	15.6521	0.0000	80.50		

Blockwise status of groundwater quality hazards in groundwater				
S.N	Block	No. of villages with Fluoride contents ≥ 1.5 ppm	No. of villages with nitrate contents > 45 ppm	No. of villages with $Ec > 3000$ micro-mhos/cm
1	Amer	39	91	06
2	Bairath	10	33	01
3	Bassi	84	78	30
4	Chaksu	185	78	70
5	Dudu	97	88	94
6	Govindgarh	24	35	01
7	J. Ramgarh	32	88	24
8	Jhotwara	29	61	05
9	Kotputli	51	71	23
10	Phagi	119	93	109
11	Sambhar	125	123	61
12	Sanganer	121	96	20
13	Shahpura	21	45	07

supplies also hinders groundwater pumping/piped water supply and hence water crisis in the State.

MANAGEMENT STRATEGIES

There is solution for every problem and so is the case with water crisis in the State of Rajasthan. Water management strategies are four fold comprising of:

- ◆ Research and Development
- ◆ Water Conservation
- ◆ Augmentation of Water Resources
- ◆ Regulatory measures

1. Research and Development

Water related organizations needs to promote research and development activities jointly with the Universities and other research institutions to access the availability of safe drinking water and to augment the resources by artificial recharge. R & D studies viz. suitable recharge structures in diversified geohydrologic & climatic conditions, improved filter media in sandy area etc. Genesis of quality hazards including salinity, high fluoride and nitrate contents and industrial pollution needs to be studied in order to protect the ground water resources through various innovative and integrated techniques. Management strategies/policies in the State be formulated as per findings of such scientific studies.

2. Conservation of Water

To save water amounts to produce water in that area. Conservation of water is of paramount importance and need of the hour. Policy of reward and punishment needs to be introduced. Financial incentives in terms of electricity bills etc. may be introduced for water savers and heavy water tariff and other punishment for those who waste this precious resource.

2.1 Irrigation sector- The largest water consumer

Sprinkler and drip system of irrigation should be promoted and made mandatory in phased manner, wherever feasible. This is needed in canal command areas also so as to minimize return seepage from irrigation and thereby water logged problem.

- ◆ Metering system over wells / tube wells may be initiated. Water charges may be framed as per slabs of quantum of water pumped.
- ◆ Low water requirement crop needs to be promoted at suitable places and markets should be developed accordingly.
- ◆ Salt tolerant crops in saline water areas especially in coarse textured soil.
- ◆ Community system of irrigation especially in deep water levels areas for
- ◆ Conjunctive use of canal and ground water to avoid land degradation by water logging/alkalinity.

2.2 Domestic sector

- ◆ Reuse of domestic wastewater for gardening.
- ◆ Bathing just with a bucket of water instead of using fountain / Bathtub, which can save water to the tune of 100 litres per day per person
- ◆ Using value system in toilets rather than flushing tanks that can save about 10 litres of water per person per trip
- ◆ Making use of just $\frac{1}{2}$ a lt. container for saving instead of flowing water from taps. Thus, conserving water to the tune of about 4-5 litres per shave.
- ◆ Small container may be used for brushing teeth in place of using taps.
- ◆ Don't waste water from taps for washing clothes. A bucket water may be sufficient for such washing.
- ◆ Leakage's from pipelines for water supply to urban / rural areas be checked properly by the concerned organization / societies.
- ◆ Supply of inferior quality of water for purposes other than drinking.
- ◆ Blending of low standard water with fresh water for drinking water supplies, wherever possible.
- ◆ Construction of hand pumps may



3. Artificial recharge to ground water

A massive programme needs to be taken up for artificial recharge to ground water using suitable techniques like roof top rainwater harvesting, constructing check dams across streams / rivers and nallas etc. Watershed development and management projects are also to be taken up especially in hard rock terrain. Water is a finite resource. We cannot afford to misuse it any more particularly in drought prone arid zones such as Rajasthan. Storage of rainwater within the earth by artificial recharge to groundwater on large scale needs to be initiated specially to avoid

evapotranspiration losses & to minimize risk of pollution. The additional availability of groundwater resources may be retrieved at any point of time and space and hence drought proofing of permanent nature in the State.

4. REGULATORY MEASURES

♦ Creation of Ground Water Sanctuaries

With the objectives of efficient water management, fresh groundwater potential areas may be declared as "Ground Water Sanctuaries" in the areas where significant decline in water levels may or may not be there but such aquifers are crucial for drinking water supply. Potential groundwater areas like Lathi basin area are required to be declared as "Ground Water Sanctuaries".

♦ Mass Awareness and Training Programme

In addition to the institutional efforts, sustainable development and management of water resources needs motivation and mobilization of community and peoples participation

so as to bring attitudinal changes as regards conservation and augmentation of the precious mineral called water. Organizing Mass awareness Programms, electronic and press media and arranging training programmes have been proved as meaningful ways and means to educate the masses at grass root level.

♦ Notification of the Area

With the direction of Hon'ble Supreme Court of India, Ministry of Forest and Environment has constituted "Central Ground Water Authority" (CGWA) under "Environment (Protection) Act 1986". Enforcement of effective regulation and management options of ground water resources may be undertaken after Notification of the vulnerable areas by the CGWA. Constitution of State Ground Water and District Ground Water Authorities for effective enforcement of the proposed management options of the CGWA is need of the hour. CGWA has already notified 12 blocks/areas for control and regulation of groundwater resources in Rajasthan State.

♦ Participatory management

Water resource management with cohesive participatory approach of various agencies has attained paramount importance because of perennial requirement of water for sustaining the life on the planet earth. The effective water management calls for defining role and responsibility of the water manager partners including policy planners, Central and State organizations, Non Government Organizations (NGO's), Voluntary Organizations (VO's), Universities-Research Institutes, Public Representatives, Industries, Common people etc. Constitution of Water-Sanitation Committee (WATSON) / Water User Association (WUA) at village, city and colony level incorporating scientists, engineers, administrators, doctors, academicians etc. may be a boon for efficient water - sanitation management for catering safe water.

*(Author is Scientist in Central Ground Water Board, Jaipur)

GROUND WATER SCENARIO OF JAIPUR

■ L.N. Mathur

Jaipur district with geographical area of 11,061.44 sq. km forms east-central part of the State extending between north latitudes 26° 25' & 27° 51' and east longitudes 74° 55' & 76° 15'. Jaipur, the capital city is also popularly known as Pink city and is situated towards central part of the district. According to 2001 census, total population of Jaipur district was 52,52,338. The semi-arid district receives normal annual rainfall of 527mm (1901-71) while average annual rainfall for the last 30 years (1977-2006) is 565mm. Over 90% of total annual rainfall is received during monsoon. Total annual Potential evapotranspiration is 1744mm. Though, Jaipur city has experienced floods in 1981, the district area is prone to drought spells as witnessed from 1984 to 1989 and 1999 to 2002. District is characterized by landscapes including hillocks, pediments, undulating fluvial plains, aeolian dune fields, ravines, palaeo-channels etc. Structural hills mainly in north and NE parts trends NNE-SSW are mainly composed of Delhi Quartzite. The district area is drained by ephemeral rivers Sabi, Banganga, Bandi, Mendha, Mashi, Sota and their tributaries.

2. Ground Water Scenario

2.1 Hydrogeology

Gneisses and schists of Bhilwara Super Group are the oldest rock types overlain by quartzites, schists, conglomerates, dolomitic limestone etc. belonging to Alwar & Ajabgarh Groups of Delhi Super Group along with granite, pegmatite & amphibolite intrusives of Post Delhi age. A hard rock in major parts of the district is covered by Quaternary fluvial & aeolian deposits mainly composed of sand, silt, clay, gravel & kankars. Alluvial thickness is

less in southern & SW parts of the district i.e. in Naraina, Sakun, Dudu, Mozamabad, Phagi, Chaksu area etc. Alluvial thickness between 90 & 100m has been observed at Chomu, Jairampura, Nangal Bharra, Dhaunata area where its

Bajaj Nagar (Jaipur city) and Shahpura, Dhanauta, Nayan, Kalyanpur, Mohana and Chandalai. Hard rocks of Bhilwara Super Group forms main aquifers in Southern and South western parts of the district in Dudu, Phagi and Chaksu

Increasing rate of Water level decline in time and space									
S.N	Block	Average WL 1984 (m)	Average WL 1996 (m)	Average WL 2001 (m)	Average WL 2006 (m)	WL Fluctuation Pre-Post 2006	Rate of WL decline 84-06 (m/yr)	Rate of WL decline 96-06 (m/yr)	Rate of WL decline 01-06 (m/yr)
1	Amer	16.90	18.54	21.53	32.51	-0.90	0.71	1.4	2.20
2	Bairath	11.79	15.68	16.45	23.65	-0.98	0.54	0.8	1.44
3	Bassi	11.39	18.80	27.79	29.45	-0.41	0.82	1.07	0.33
4	Chaksu	9.62	11.85	13.58	22.73	1.60	0.60	1.09	1.83
5	Dudu	10.35	13.97	15.87	19.98	-0.98	0.44	0.60	0.82
6	Govindgarh	10.75	16.74	20.84	30.41	-0.15	0.89	1.37	1.91
7	J.Ramgarh	12.12	20.09	21.77	24.58	0.93	0.57	0.45	0.56
8	Jhotwara	13.81	24.86	28.82	41.25	-0.83	1.24	1.64	2.49
9	Kotputli	10.05	15.91	18.24	21.79	-0.55	0.53	0.59	0.71
10	Phagi	10.03	12.17	13.03	17.40	0.21	0.33	0.52	0.87
11	Sambhar	11.21	18.41	21.74	33.51	1.72	1.01	1.51	2.35
12	Sanganer	14.58	23.45	28.30	36.88	2.24	1.01	1.34	1.72
13	Shahpura	16.80	24.63	28.56	31.10	-0.70	0.65	0.65	0.51

Blockwise status of groundwater quality hazards in groundwater				
S.N	Block	No. of villages with Fluoride contents ≥ 1.5 ppm	No. of villages with nitrate contents > 45 ppm	No. of villages with Ec ≥ 3000 micro-mhos/cm
1	Amer	39	91	06
2	Bairath	10	33	01
3	Bassi	84	78	30
4	Chaksu	185	78	70
5	Dudu	97	88	94
6	Govindgarh	24	35	01
7	J. Ramgarh	32	88	24
8	Jhotwara	29	61	05
9	Kotputli	51	71	23
10	Phagi	119	93	109
11	Sambhar	125	123	61
12	Sanganer	121	96	20
13	Shahpura	21	45	07

thickness over 100m has been found at Risani village (104m). Groundwater in the district occurs both in unconsolidated Quaternary formations and consolidated formations of Bhilwara & Delhi Super Groups and also Post Delhi Granites. In greater parts of the district, alluvial deposits mainly fine sand & silt serve as potential aquifers in addition to gravel deposits as found at Sanganer, Ambabari,

blocks comprising of granulitic gneisses, quart mica schist, phyllites along with granite & pegmatite intrusive. Similarly, quartzite, schist & phyllites of Delhi Super Group forms aquifers in Jamwa Ramgarh, Bairath, Kotputli, Shahpura, Amer and Bassi blocks. Movement of groundwater in these hard rocks is controlled by size, continuity and interconnectivity of weathered and

fracturing and other secondary porosities. Depth to water levels in the district ranges from minimum of 10.30 at Sewa in Dudu district to deepest at 70.20m at Chomu in Govindgarh block. Depth to water level in most parts of northern block areas (i.e. parts of Shahpura, Kotputli, Bairath), eastern parts in Jamwa Ramgarh block and southern parts (parts of Chaksu, Phagi, Dudu & Sambhar) is less than 25m. In larger Central parts of the district have more than 25m water levels and even over 50m in parts of Jhotwara/Amer block in Bindayaka area, Devliya area in northern Sambhar block and in Chomu area of Govindgarh block. Over-exploitation of groundwater resources have set declining trend in water levels. Even average Premonsoon-Postmonsoon water levels show decline in most of the blocks indicating significant withdrawal as compared to natural recharge to groundwater.

2.2 Ground Water Quality

Quality of groundwater is good for drinking and irrigation in major parts. In larger parts Electrical conductance is less than 3000 micro-mhos/cm. However, high salinity in groundwater has been observed in parts of Jamwa Ramgarh, Bassi, Phagi, Dudu and Sambhar blocks. High fluoride contents have been found in parts of Sanganer, Sambhar, Dudu, Chaksu, Phagi blocks.

2.4 Status of Ground Water Development (See-Table)

Ground water development was mainly done earlier by dug wells. With the declining of water levels, deepening of these dug wells has taken place (DCB) or is replaced by tube wells.

Jaipur Urban Area

Requirement for water resources has been rising in the urban agglomerates due to population explosion and growth in commercial activities along with social needs and comfort resulting in crumbling of existing systems of water supply and sanitation. This rapacious exploitation of water is bound to end up in no water situation and an ecological crisis, if the required preventive measures are not

2.3 Ground Water Resources as on 31.03.2007

Block	Area of Block (Sq.Km.)	Type of Area	Potential Zone	Potential Zone Area (Sq.Km.)	Net Annual Ground Water Availability (mcm)	Existing Gross Ground Water (mcm)	Existing Gross Ground Water Draft for Irrig. Use (mcm)	Existing Gross Ground Water Draft for Dom.& Indus. Use (mcm)	Allocation for All Uses (mcm)	Industrial Requirement As Projected for the Year 2025 (mcm)	Stage of Ground Water Development (%)	Category
Amer	898.64	NC	A	746.46	57.1690	99.3551	8.2307	107.5858	20.2160	188.19		
		NC	Q	104.02	5.7584	6.6073	6.0867	12.6940	7.8253	220.45		
Block Total				850.48	62.9273	105.9624	14.3175	120.2799	28.0413	191.14	O.E.	
Bairath	706.10	NC	A	588.38	43.3962	34.5655	8.8122	43.3776	9.2748	99.96		
		NC	Q	75.60	2.7601	3.2436	1.6032	4.8468	3.8263	175.60		
Block Total				663.98	46.1563	37.8091	10.4154	48.2245	13.1011	104.48	O.E.	
Bassi	654.69	NC	A	218.85	14.1655	17.0586	6.0604	23.1190	12.2500	163.21		
		NC	Ao	357.62	25.1501	47.5332	3.3995	50.9327	8.0560	202.51		
		NC	Q	54.76	1.5385	3.4073	1.0445	4.4518	2.4763	289.35		
Block Total				631.23	40.8542	67.9991	10.5044	78.5035	22.7823	192.16	O.E.	
Chaksu	811.92	NC	Ao	552.06	35.2286	54.4657	2.7771	57.2428	7.8200	162.49		
		NC	Sc	177.30	5.9030	9.5722	1.5790	11.1511	2.6010	188.90		
Block Total				729.36	41.1316	64.0379	4.3561	68.3939	10.4210	166.28	O.E.	
Dudu	1870.64	NC	Ao	327.26	18.2569	18.5569	4.1236	22.6805	5.9062	124.23		
		NC	Sc	407.93	18.3264	8.3038	2.4667	10.7705	3.7700	58.77		
		NC	Gn	1055.68	26.4321	17.6310	7.9719	25.6029	11.5600	96.86		
Block Total				1790.87	63.0154	44.4917	14.5622	59.0539	21.2362	93.71	Critical	
Govindgarh	685.12	NC	A	638.08	50.9257	114.9540	10.9342	125.8882	19.1600	247.20		
Block Total				638.08	50.9257	114.9540	10.9342	125.8882	19.1600	247.20	O.E.	
J.Ramgarh	1033.70	NC	A	577.82	34.8713	46.3735	3.2856	49.6591	4.4000	142.41		
		NC	Q1	96.85	3.2801	5.7069	0.7225	6.4294	0.7400	196.01		
		NC	Q2	78.95	2.6536	4.5013	0.2870	4.7883	0.5900	180.45		
		NC	Sc	136.01	3.9195	2.9254	0.6855	3.6109	1.0200	92.13		
		NC	G	72.25	1.8154	1.5600	0.2343	1.7943	0.5900	98.84		
Block Total				961.88	46.5399	61.0671	5.2150	66.2821	7.3400	142.42	O.E.	
Jhotwara	568.79	NC	A	553.04	49.9523	70.9970	94.3808	165.3778	191.5900	331.07		
Block Total				553.04	49.9523	70.9970	94.3808	165.3778	191.5900	331.07	O.E.	
Kotputli	691.71	NC	A	442.21	47.8028	75.7416	8.0493	83.7909	13.1300	175.28		
		NC	Q	130.54	4.3910	5.6794	1.0918	6.7712	1.9700	154.21		
Block Total				572.75	52.1938	81.4210	9.1411	90.5621	15.1000	173.51	O.E.	
Phagi	1114.34	NC	Ao	396.11	32.3141	25.9032	2.4005	28.3037	2.4100	87.59		
		NC	Sc	73.40	1.9547	1.8727	0.3978	2.2705	0.4200	116.15		
Shahpura	429.85	NC	A	384.14	27.6890	48.2402	8.3627	56.6029	19.8833	204.42		
Block Total				384.14	27.6890	48.2402	8.3627	56.6029	19.8833	204.42	O.E.	
Phagi		Saline	Ao(S)	340.06	19.4435	15.6521	0.0000	15.6521	0.0000	80.50		
Total of District (Excluding saline)	11061.4	NC		9994.67	609.2532	919.9622	216.8946	1136.8568	410.2900	186.60		
Total of Saline zones		SAL		340.06	19.4435	15.6521	0.0000	15.6521	0.0000	80.50		

taken up in time. In Jaipur urban agglomerate, surface water resources like Ramgarh Lake are generally empty and groundwater contributes over 95% of water supply. Present aerial dimensions of the urban area lies between north latitudes $26^{\circ}47' - 27^{\circ}02'$ and east longitudes $75^{\circ}36' - 75^{\circ}55'$ located almost in the centre of the district and cover an area of about 470 km². With the increase in rate of urbanization, population of the city has also increased many folds i.e. about 16 times during the period 1931-2006. The urban agglomerate is occupied by landforms including sandy-plains, hills and intermountain valleys, pediments etc. Streamlet originating from Nahargarh hills namely Amanishah Nalla (ephemeral) flows southerly up to Sanganer area where it takes easterly flow direction. Surface water in extreme western part of the urban area flows in westerly direction and discharges through Bandi river. Average annual rainfall 640 mm. Rate of potential evapotranspiration is high.

Rocks of Bhilwara Super Group comprising mainly of gneisses and schists (Archaean age) are overlain by quartzite with inter-bedded phyllite and schist sequence of Alwar Group (Delhi Super Group) mostly covered under Quaternary deposits in major parts of the urban area. The unconsolidated fluvial and aeolian sediments are mainly composed of sand, silt, gravel and clay with kankar. Porous and permeable unconsolidated formations permit horizontal and vertical spread of nitrate and fluoride pollution. Unconsolidated Quaternary formations form the principal aquifer system saturated thickness of which varies considerably. Depth to water level varies from 11m to 50m. Depth to water level in the central part of the area covering walled city, Amer, Jal Mahal is shallower i.e. below 20m and forms a mound. Shallower groundwater level in walled city areas especially during ancient times coupled with lack of proper sewerage system might have facilitated rapid nitrate pollution. The groundwater flow is southerly. Hydro-chemical studies reveal that electrical conductivity of groundwater is generally less than 3000 micro-mhos/cm at 25° C in major parts of the urban area except parts of walled city where it is brackish. groundwater is of

S.N	Block	Potent -ial Zone	Mode of lift	Irrigation & domestic draft by various types of abstraction structures					
				Irrigation draft			Domestic draft		
				No.of Wells	Average Yield (m ³ /d)	Draft (mcm)	No.of Wells	Average Yield (m ³ /d)	Draft (mcm)
1	AMER	A	DW /DCB With Pumps	7331	71.7	63.0759	541	10	1.9747
			DW /DCB Without Pumps			619	2.1	0.4745	
			Tube well			198	80	5.7816	71.3066
		Q	DW /DCB With Pumps	2527	40	12.1296	1002	10	3.6573
			DW /DCB Without Pumps			1360	2100	1.0424	
			Tube well			152	25000	1.3870	18.2163
2	BAIRATH	A	DW /DCB With Pumps	3084	93.4	34.5655	163	93.4	5.5568
			DW /DCB Without Pumps			347	2.1	0.2660	
			Tube well			63	130	2.9894	43.3776
		Q	DW /DCB With Pumps	515	55	3.3990	38	55	0.7629
			DW /DCB Without Pumps			44	2.1	0.0337	
			Tube well			26	85	0.8067	5.0022
3	BASSI	A	DW /DCB With Pumps	2187	65	17.0586	117	80	3.4164
			DW /DCB Without Pumps			359	2100	0.2752	
			Tube well			59	110000	2.3689	23.1190
		Ao	DW /DCB With Pumps	7043	65	54.9354	83	65	1.9692
			DW /DCB Without Pumps			247	2.1	0.1893	
			Tube well			34	100	1.2410	58.3349
		Q	DW /DCB With Pumps	827	52.5	5.2101	28	52.5	0.5366
			DW /DCB Without Pumps			96	2.1	0.0736	
			Tube well			14	85	0.4344	6.2546
		Sc	DW /DCB With Pumps	6163	70	51.7692	80	70	2.0440
			DW /DCB Without Pumps			185	2.1	0.1418	
			Tube well			18	90	0.5913	54.5463
4	CHAKSU	Ao	DW /DCB With Pumps	1534	52	9.5722	53	52	1.0059
			DW /DCB Without Pumps			69	2.1	0.0529	
			Tube well			19	75	0.5201	11.1511
		Sc	DW /DCB With Pumps	2713	57	18.5569	129	57	2.6838
			DW /DCB Without Pumps			164	2.1	0.1257	
			Tube well			36	100	1.3140	22.6805
5	DUDU	Gn	DW /DCB With Pumps	1821	38	8.3038	126	38	1.7476
			DW /DCB Without Pumps			331	2.1	0.2537	
			Tube well			17	75	0.4654	10.7705
		Sc	DW /DCB With Pumps	3265	45	17.6310	389	45	6.3893
			DW /DCB Without Pumps			529	2.1	0.4055	
			Tube well			43	75	1.1771	25.6029
6	GOVINDGARH	A	DW /DCB With Pumps	10948	87.5	114.9540	160	87.5	5.1100
			DW /DCB Without Pumps			227	2.1	0.1740	
			Tube well			129	120	5.6502	125.8882
		Q2	DW /DCB With Pumps	3189	85	32.5278	47	85	1.4582
			DW /DCB Without Pumps			327	2.1	0.2506	
			Tube well			36	120	1.5768	35.8134
7	J.RAMGARH	Q	DW /DCB With Pumps	1171	45	6.3234	19	45	0.3121
			DW /DCB Without Pumps			64	2.1	0.0491	
			Tube well			11	90	0.3614	7.0459
		Sc	DW /DCB With Pumps	1098	45	5.9292	7	45	0.1150
			DW /DCB Without Pumps			34	2.1	0.0261	
			Tube well			5	80	0.1460	6.2162
		G	DW /DCB With Pumps	1065	45	5.7510	14	45	0.2300
			DW /DCB Without Pumps			61	2.1	0.0468	
			Tube well			14	80	0.4088	6.4365
		Sc	DW /DCB With Pumps	325	40	1.5600	8	40	0.1168
			DW /DCB Without Pumps			20	2.1	0.0153	
			Tube well			4	70	0.1022	1.7943
8	JHOTWARA	A	DW /DCB With Pumps	6131	96.5	70.9970	4060	10	14.8190
			DW /DCB Without Pumps			2156	2.1	1.6526	
			Tube well			1423	150	77.9093	165.3778
9	KOTPUTLI	Q	DW /DCB With Pumps	6644	95	75.7416	134	95	4.6465
			DW /DCB Without Pumps			230	2.1	0.1763	
			Tube well			68	130	3.2266	83.7909
		Gn	DW /DCB With Pumps	2111	40	10.1328	45	40	0.6570
			DW /DCB Without Pumps			72	2.1	0.0552	
			Tube well			13	80	0.3796	11.2246
10	PHAGI	Ao	DW /DCB With Pumps	2135	60	15.3720	80	60	1.7520
			DW /DCB Without Pumps			96	2.1	0.0736	
			Tube well			15	105	0.5749	17.7725
		Sc	DW /DCB With Pumps	503	43.5	2.6257	17	43.5	0.2699
			DW /DCB Without Pumps			24	2.1	0.0184	
			Tube well			4	75	0.1095	3.0235
		Gn	DW /DCB With Pumps	2569	43.4	13.3794	15	43.4	0.2376
			DW /DCB Without Pumps			82	2.1	0.0629	
			Tube well			3	70	0.0767	13.7565
11	SAMBHER	A	DW /DCB With Pumps	5062	69.5	42.2171	298	10	1.0877
			DW /DCB Without Pumps			665	2.1	0.5097	
			Tube well			89	80	2.5988	46.4133
		Ao	DW /DCB With Pumps	9952	69.5	82.9997	861	10	3.1427
			DW /DCB Without Pumps			651	2.1	0.4990	
			Tube well			98	70	2.5039	89.1452
12	SANGANER	A	DW /DCB With Pumps	9321	81.3	90.9357	1689	10	6.1649
			DW /DCB Without Pumps			1557	2.1	1.1934	
			Tube well			421	90	13.8299	112.1238
13	SHAHPUR	A	DW /DCB With Pumps	5712	70	47.9808	59	95	2.0458
			DW /DCB Without Pumps			565	2.1	0.4331	
			Tube well			124	130	5.8838	56.3435

A-Alluvium Ao-Older alluvium Q-Quartzite Gn -Gneiss Sc -Schist G-Granite

Depth to water level and its rate of decline									
S.N	Location	Depth to Water level (m)		Rate of WL decline (m/year)	S . N	Location	Depth to Water level (m)		Rate of WL decline (m/year)
		2001	2006				2001	2006	
1	Durgapura	24.11	35.48	2.27	5	Sirsi	42.98	55.51	2.51
2	Jhotwara	45.90	55.62	1.94	6	Surya Nagar	17.46	21.72	0.85
3	MES	38.77	55.22	3.29	7	Sukhpuria	23.02	27.10	0.82
4	Mansarovar	25.25	38.01	2.55	8	Watika	24.08	36.58	2.52

Ca-Mg Cl SO₄ NO₃ type, nitrate being the predominant ion and permanent hardness. In sub extreme urban areas it is generally of Na-HCO₃ type without any hardness. In remaining areas of urban agglomerate, groundwater is of mixed type with Ca-Mg-HCO₃ being the predominant ions. High levels of fluoride contents in ground water (> 1.5 ppm) is mainly geogenic and partly pollution from dyeing and printing industries spreading through Amanishah and other nallas, canals, return irrigation seepage etc in Sanganer block area. High nitrate in groundwater

has been recorded in the Jaipur city, particularly within the walled city and adjoining colonies including Jal Mahal Lake area, Gaitor and Kala Hanuman Ji Mandir area C-scheme, Bani Park, Civil lines, Jyoti Nagar, Adarsh Nagar, Tilak Nagar, southern part of Shastri Nagar and Sikar house etc.

Annual groundwater recharge in the urban area is about 35.6 Million Cubic Metre (MCM)/Year whereas total draft for all purposes is of the tune of 100 MCM/year with over exploitation/over draft of about 64.4 MCM/year (stage of

groundwater development of 280.90%). Static groundwater resources have been estimated for Jaipur urban area of the tune of 400MCM. Over exploitation of groundwater with even present pace may lead to complete drying up of alluvium aquifers within 6 years, if the necessary remedial measures are not initiated on urgent basis

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*(Author is Scientist in Central Ground Water Board, Jaipur)

यानी है जीवन वरदान

पानी पानी तेरी महिमा सब जग का आधार महान
दान में दे कोई सोना चांदी- न दे जीवन दान
पानी है जीवन वरदान - पानी है जीवन वरदान
लाल न पीला काला न नीला - तेरा अद्भुत रंग है
जिस रंग में तू मिल जाता है - तू तो उसके संग है
तेरी सौम्य प्रकृति पानी - सब रहे दिल से मान
पानी है जीवन वरदान - पानी है जीवन वरदान
खाये बिन कोई रह जाये पर - पानी बिन रहे कोई कैसे
जल में रहने वाली मछली जल बिन प्राण तजे जैसे
वनस्पति चाहे जीवन जन्तु - सबका जीवन प्राण
पानी है जीवन वरदान - पानी है जीवन वरदान

पानी है वरदान प्रकृति का, पानी को प्रिय पहचानो
पानी जीवन पानी अमृत, ये अनमोल है तुम मानो
इक-इक बूँद का मोल करो तुम, अटल ये सत्य महान
पानी है जीवन वरदान - पानी है जीवन वरदान
जिसका न आकार रूप, जो तरल बनके बहता
पूर्ण पृथ्वी का भार वो पानी, बनके सरल सरपे सहता
कहे कुमार वो जितना सरल वो - उतना ही गुणवान
पानी है जीवन वरदान - पानी है जीवन वरदान

-लेखक : कुमार नरेन्द्र, जयपुर

Drinking Water Status in Rajasthan

■ Ratan Singh



Rajasthan is the largest state of the country covering a geographical area of 3.42 lac sq. km, which is about 10% of the country's area. A number of 56.5 million people inhabit 222 towns and 37889 villages of the state. A comparison of important parameters and state's surface water resource with that of country's total is given below:

Particulars	%Compared to Country
Rajasthan	Largest State of the Country
Area	10
Human Population	5.5
Animal Population	18.70
Irrigated Area	13.88
Food Grain Production	6.55
Surface Water Source	1.16

Ground Water Source:

Most of the drinking water schemes, about 94%, are based on groundwater sources. But, share of drinking water in total drawn groundwater is only 10%, while remaining 90% is being used for irrigation of crops. As a result of over exploitation, water level is declining in 30 out of 32 districts of the state ranging from (-)0.22 to (-) 10.55 metre from the year 1998 to 2004. Status of the groundwater in state is as follows:

Total block in the state	Over exploited block	Critical (Dark) blocks	Semi critical (Gray) blocks	Safe blocks	With completely saline water (Taranagar)
237	140	50	14	32	1

Scenario-Urban Sector

The state of Rajasthan has 222 urban towns and all of these towns are covered by water supply system. Out of these towns, 18% are based on surface sources and 68% on groundwater sources. 14% towns depend on both the surface source as groundwater sources. Out of six major towns namely; Jaipur, Ajmer, Kota, Bikaner, Jodhpur and Udaipur. Only Jaipur is dependent on the groundwater due to non availability of water in Ramgarh Dam. Jodhpur and Bikaner are now based on Indira Gandhi Canal System. Ajmer is connected with the Bisalpur dam system and Kota on the river Chambal. These surface water sources are dependable and sustainable. Drinking water is supplied at intervals of 24 hours in 161 towns, 48 hours in 58 towns and 72 hours in 3 towns. The service level range of all the towns is as follows:

No. of Towns	Liters Per Capita per Day (Range)
13	20-40
60	40-60
83	60-80
35	80-100
31	Above 100

Scenario Rural Sector (Coverage up to August 2007)

Town / Habitation		Total		Benefited (Out of Col.3) as on	
	(2001 Census)	(91 Census)		March 2007	August 2007
1	2	3		4	5
Towns	222	222		222	222
Villages (Main Habitations)	39753	37889		37859	37859
Dhani / Majra (Other Habitations)	82497 (3003 Survey)	56057 (1999 Survey)		54598	54638
Total Habitations	122250	93946		92457	92497

Status of NC (Not Covered) Habitations (CAP 99)

Particulars		Balance NC Habitations		
		Main	Other	Total
Remaining on 31.3.07	30	1459	1489	
Covered During 2007- 2008 (up to August'07)	0	40	40	

Status of habitations as on 1/04/2005 as per survey 2003

Particulars of Habitations	Nos.
Not Covered habitations due to quality (NC Quality)	34,183
Slipped Back Not Covered habitations (Slipped Back NC)	31,030
Total Not Covered (NC) Habitations 1+2	65,213
Slipped back Partially Covered habitations (Slipped Back PC)	17,159
Total Load for Coverage 1+2+3	82,372
Fully Covered habitations (FC)	39,878
Total Habitations 1+2+3+4	1,22,250

Quality of Water:

Rajasthan state has to face water problem regarding both quantity as well as quality of water. Magnitude of Quality Problem India v/s Rajasthan, Validated up to 31-04-2004, is as follows.

Sr. No.	Particulars	India	Rajasthan			% Compared to Country
			Villages	Habitations	Total	
1	Multiple Quality Problem	25092	9572	9067	18639	74.28
2	Only Fluoride	31306	4477	4515	8992	28.72
3	Only Salinity	23495	3235	2193	5428	23.10
4	Only Nitrate	13958	4211	3671	7882	56.47
5	Only Iron	118088	79	52	131	0.11
6	Only Arsenic	5029	0	0	0	0.00

Shift to Surface Water Source :

In view of poor availability and declining ground water quality, the state government has taken a policy decision to shift the drinking water schemes from groundwater to surface water sources. All the Major Projects have been sanctioned with surface water as source. In all, 54 projects, costing Rs. 8028.69 crore, have been sanctioned. These projects envisage covering 65 towns, 6848 main habitation and 2964 other habitations. Up to August 2007, 6 projects have been completed covering 8 towns, 777 main habitation and 2713 other habitations.

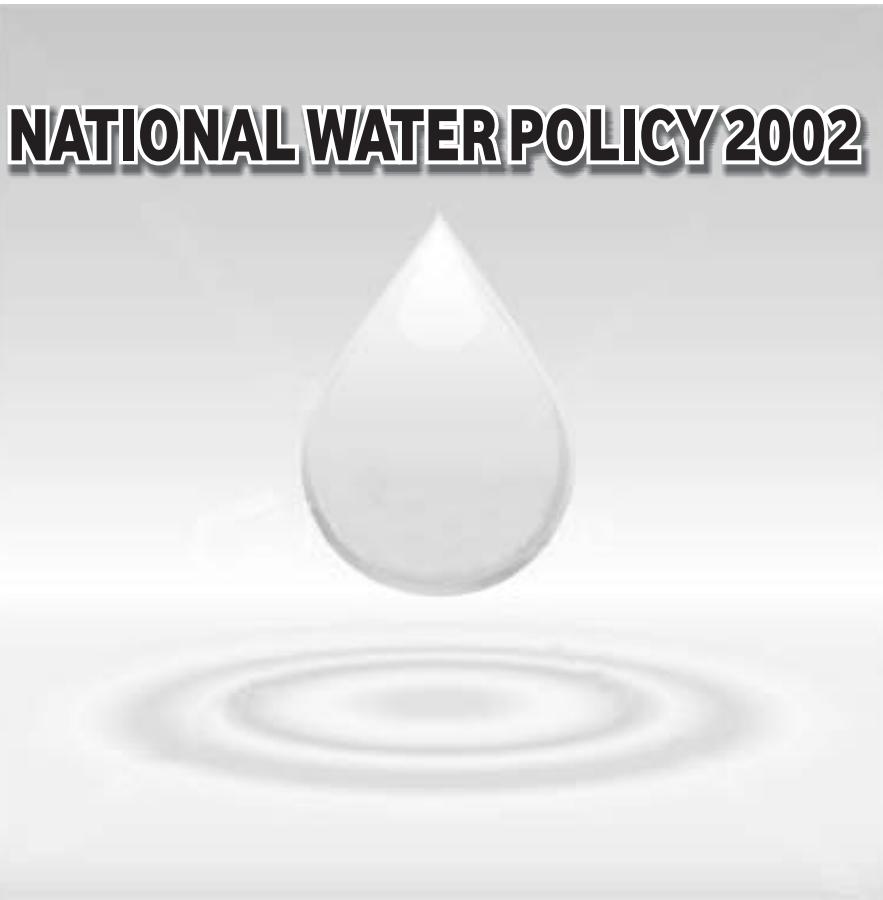
*(Author is Retd. Chief Engineer PHED, Rajasthan)

1.1 Water is a prime natural resource, a basic human need and a precious national asset. Planning, Development and management of water resources need to be governed by national perspectives.

1.2 As per the latest assessment (1993), out of the total precipitation, including snowfall, of around 4000 billion cubic meter in the country, the availability from surface water and replenishable ground water is put at 1869 billion cubic meter. Because of topographical and other constraints, about 60% of this i.e. 690 billion cubic meter from surface water and 432 billion cubic meter from ground water, can be put to beneficial use. Availability of water is highly uneven in both space and time. Precipitation is confined to only about three or four months in a year and varies from 100 mm in the western parts of Rajasthan to over 10000 mm at Cherrapunji in Meghalaya. Rivers and under ground aquifers often cut across state boundaries. Water, as a resource is one and indivisible: rainfall, river waters, surface ponds and lakes and ground water are all part of one system.

1.3 Water is part of a larger ecological system. Realising the importance and scarcity attached to the fresh water, it has to be treated as an essential environment for sustaining all life forms.

1.4 Water is a scarce and precious national resource to be planned, developed, conserved and managed as such, and on an integrated and environmentally sound basis, keeping in view the socio-



economic aspects and needs of the States. It is one of the most crucial elements in developmental planning. As the country has entered the 21st century, efforts to develop, conserve, utilise and manage this important resource in a sustainable manner, have to be guided by the national perspective.

1.5 Floods and droughts affect vast areas of the country, transcending state boundaries. One-sixth area of the country is drought-prone. Out of 40 million hectare of the flood prone area in the country, on an average, floods affect an area of around 7.5 million hectare per year. Approach to management of droughts and floods has to be co-ordinated and guided at the national level.

1.6 Planning and implementation of water resources projects involve a number of socio-economic aspects and issues such as environmental sustainability, appropriate resettlement and rehabilitation of project-affected people and livestock, public health concerns of water impoundment, dam safety etc. Common approaches and guidelines are necessary on these matters. Moreover, certain problems and weaknesses have affected a large number of water resources projects all over the country. There have been substantial time and cost overruns on projects. Problems of water logging and soil salinity have emerged in some irrigation commands, leading to the degradation of

agricultural land. Complex issues of equity and social justice in regard to water distribution are required to be addressed. The development and overexploitation of groundwater resources in certain parts of the country have raised the concern and need for judicious and scientific resource management and conservation. All these concerns need to be addressed on the basis of common policies and strategies.

1.7 Growth process and the expansion of economic activities inevitably lead to increasing demands for water for diverse purposes: domestic, industrial, agricultural, hydro-power, thermal-power, navigation, recreation, etc. So far, the major consumptive use of water has been for irrigation. While the gross irrigation potential is estimated to have increased from 19.5 million hectare at the time of independence to about 95 million hectare by the end of the Year 1999-2000, further development of a substantial order is necessary if the food and fiber needs of our growing population are to be met with. The country's population which is over 1027 million (2001 AD) at present is expected to reach a level of around 1390 million by 2025 AD.

1.8 Production of food grains has increased from around 50 million tones in the fifties to about 208 million tones in the Year 1999-2000. This will have to be raised to around 350 million tones by the year 2025 AD. The drinking water needs of people and livestock have also to be met. Domestic and

industrial water needs have largely been concentrated in or near major cities. However, the demand in rural areas is expected to increase sharply as the development programmes improve economic conditions of the rural masses. Demand for water for hydro and thermal power generation and for other industrial uses is also increasing substantially. As a result, water, which is already a scarce resource, will become even scarcer in future. This underscores the need for the utmost efficiency in water utilisation and a public awareness of the importance of its conservation.

1.9 Another important aspect is water quality. Improvements in existing strategies, innovation of new techniques resting on a strong science and technology base are needed to eliminate the pollution of surface and ground water resources, to improve water quality. Science and technology and training have to play important roles in water resources development and management in general.

1.10 National Water Policy was adopted in September, 1987. Since then, a number of issues and challenges have emerged in the development and management of the water resources. Therefore, the National Water Policy (1987) has been reviewed and updated.

Information System

2.1 A well developed information system, for water related data in its entirety, at the national/state level, is a prime requisite for resource planning. A standardised national information system

should be established with a network of data banks and data bases, integrating and strengthening the existing Central and State level agencies and improving the quality of data and the processing capabilities.

2.2 Standards for coding, classification, processing of data and methods / procedures for its collection should be adopted. Advances in information technology must be introduced to create a modern information system promoting free exchange of data among various agencies. Special efforts should be made to develop and continuously upgrade technological capability to collect process and disseminate reliable data in the desired time frame.

2.3 Apart from the data regarding water availability and actual water use, the system should also include comprehensive and reliable projections of future demands of water for diverse purposes.

Water Resources Planning

3.1 Water resources available to the country should be brought within the category of utilisable resources to the maximum possible extent.

3.2 Non-conventional methods for utilisation of water such as through inter-basin transfers, artificial recharge of ground water and desalination of brackish or sea water as well as traditional water conservation practices like rainwater harvesting, including roof-top rainwater harvesting, need to be practiced to further increase the utilisable water resources. Promotion of frontier research and development, in a focused

manner, for these techniques is necessary.

3.3 Water resources development and management will have to be planned for a hydrological unit such as drainage basin as a whole or for a sub-basin, multi-sectorally, taking into account surface and ground water for sustainable use incorporating quantity and quality aspects as well as environmental considerations. All individual developmental projects and proposals should be formulated and considered within the framework of such an overall plan keeping in view the existing agreements / awards for a basin or a subbasin so that the best possible combination of options can be selected and sustained.

3.4 Watershed management through extensive soil conservation, catchment-area treatment, preservation of forests and increasing the forest cover and the construction of check-dams should be promoted. Efforts shall be to conserve the water in the catchment.

3.5 Water should be made available to water Short areas by transfer from other areas including transfers from one river basin to another, based on a national perspective, after taking into account the requirements of the areas / basins.

Institutional Mechanism

4.1 With a view to give effect to the planning, development and management of the water resources on a hydrological unit basis, along with a multi-sectoral, multi-disciplinary and participatory approach as well as integrating quality, quantity and the environmental aspects, the existing institutions at various levels under the water resources sector will have to be appropriately reoriented / reorganised and even created, wherever necessary. As maintenance of water resource schemes is under non-plan budget, it is generally being neglected. The institutional arrangements should be such that this vital aspect is given importance equal or even more than that of new constructions.

4.2 Appropriate river basin organisations should be established for the planned development and management of a river basin as a whole or sub-basins, wherever necessary. Special multi-disciplinary units should be set up to prepare comprehensive plans taking into account not only the needs of irrigation but also harmonising various other water uses, so that the available water resources are determined and put to optimum use having regard to existing agreements or awards of Tribunals under the relevant laws. The scope and powers of the river basin organisations shall be decided by the basin states themselves.

Water Allocation Priorities

- In the planning and operation of systems, water allocation priorities should be broadly as follows:
 - Drinking water
 - Irrigation
 - Hydro-power
 - Ecology
 - Agro-industries and non-agricultural industries

Navigation and other uses. However, the priorities could be modified or added if warranted by the area / region specific considerations.

Project Planning

6.1 Water resource development projects should as far as possible be planned and developed as multipurpose projects. Provision for drinking water should be a primary consideration.

6.2 The study of the likely impact of a project during construction and later on human lives, settlements, occupations, socio-economic, environment and other aspects shall form an essential component of project planning.

6.3 In the planning, implementation and operation of a project, the preservation of the quality of environment and the ecological balance should be a primary consideration. The adverse impact on the environment, if any, should be minimised and should be offset by adequate compensatory measures. The project should, nevertheless, be sustainable.

6.4 There should be an integrated and multidisciplinary approach to the planning, formulation, clearance and implementation of projects, including catchment area treatment and management, environmental and ecological aspects, the rehabilitation of affected people and command area development. The planning of projects in hilly areas should take into account the need to provide assured drinking water, possibilities of hydro-power development and the proper approach to irrigation in such areas, in the context of physical features

and constraints of the basin such as steep slopes, rapid runoff and the incidence of soil erosion. The economic evaluation of projects in such areas should also take these factors into account.

6.5 Special efforts should be made to investigate and formulate projects either in, a' for the benefit of, areas inhabited by tribal or other specially disadvantaged groups such as socially weak, scheduled castes and scheduled tribes. In other areas also, project planning should pay special attention to the needs of scheduled castes and scheduled tribes and other weaker sections of the society. The economic evaluation of projects benefiting such disadvantaged sections should also take these factors into account.

6.6 The drainage system should form an integral part of any irrigation project right from the planning stage.

6.7 Time and cost overruns and deficient realisation of benefits characterising most water related projects should be overcome by upgrading the quality of project preparation and management. The inadequate funding of projects should be obviated by an optimal allocation of resources on the basis of prioritisation, having regard to the early completion of ongoing projects as well as the need to reduce regional imbalances.

6.8 The involvement and participation of beneficiaries and other stakeholders should be encouraged right from the project planning stage itself.

Ground Water Development

7.1 There should be a periodical reassessment of the ground water potential on a scientific basis, taking into consideration the quality of the water available and economic viability of its extraction.

7.2 Exploitation of ground water resources should be so regulated as not to exceed the recharging possibilities, as also to ensure social equity. The detrimental environmental consequences of overexploitation of ground water need to be effectively prevented by the Central and State Governments. Ground water recharge projects should be developed and implemented for improving both the quality and availability of ground water resource.

7.3 Integrated and coordinated development of surface water and ground water resources and their conjunctive use, should be envisaged right from the project planning stage and should form an integral part of the project implementation.

7.4 Over exploitation of ground water should be avoided especially near the coast to prevent ingress of sea water into sweet water aquifers.

Drinking Water

8. Adequate safe drinking water facilities should be provided to the entire population both in urban and in rural areas. Irrigation and multipurpose projects should invariably include a drinking water component, wherever there is no alternative source of drinking water. Drinking water needs of human beings and animals should be the first

charge on any available water.

Irrigation

9.1 Irrigation planning either in an individual project or in a basin as a whole should take into account the irrigability of land, cost-effective irrigation options possible from all available sources of water and appropriate irrigation techniques for optimising water use efficiency. Irrigation intensity should be such as to extend the benefits of irrigation to as large a number of farm families as possible, keeping in view the need to maximise production.

9.2 There should be a close integration of water-use and land-use policies.

9.3 Water allocation in an irrigation system should be done with due regard to equity and social justice. Disparities in the availability of water between head-reach and tail-end farms and between large and small farms should be obviated by adoption of a rotational water distribution system and supply of water on a volumetric basis subject to certain ceilings and rational pricing.

9.4 Concerted efforts should be made to ensure that the irrigation potential created is fully utilised. For this purpose, the command area development approach should be adopted in all irrigation projects.

9.5 Irrigation being the largest consumer of fresh water, the aim should be to get optimal productivity per unit of water. Scientific water management, farm practices and sprinkler and drip system of irrigation should be adopted wherever feasible.

9.6 Reclamation of water logged / saline affected land by scientific and cost-effective methods should form a part of command area development programme.

Resettlement and Rehabilitation

10. Optimal use of water resources necessitates construction of storages and the consequent resettlement and rehabilitation of population. A skeletal national policy in this regard needs to be formulated so that the project affected persons share the benefits through proper rehabilitation. States should accordingly evolve their own detailed resettlement and rehabilitation policies for the sector, taking into account the local conditions. Careful planning is necessary to ensure that the construction and rehabilitation activities proceed simultaneously and smoothly.

Financial and Physical Sustainability

11. Besides creating additional water resources facilities for various uses, adequate emphasis needs to be given to the physical and financial sustainability of existing facilities. There is, therefore, a need to ensure that the water charges for various uses should be fixed in such a way that they cover at least the operation and maintenance charges of providing the service initially and a part of the capital costs subsequently. These rates should be linked directly to the quality of service provided. The subsidy on water rates to the disadvantaged and poorer sections of the society should be well targeted and transparent.

Participatory Approach to Water Resources Management

12. Management of the water resources for diverse uses

should incorporate a participatory approach; by involving not only the various governmental agencies but also the users and other stakeholders, in an effective and decisive manner, in various aspects of planning, design, development and management of the water resources schemes. Necessary legal and institutional changes should be made at various levels for the purpose, duly ensuring appropriate role for women. Water Users' Associations and the local bodies such as municipalities and *gram panchayats* should particularly be involved in the operation, maintenance and management of water infrastructures / facilities at appropriate levels progressively, with a view to eventually transfer the management of such facilities to the user groups / local bodies.

Private Sector Participation

13. Private sector participation should be encouraged in planning, development and management of water resources projects for diverse uses, wherever feasible. Private sector participation may help in introducing innovative ideas, generating financial resources and introducing corporate management and improving service efficiency and accountability to users. Depending upon the specific situations, various combinations of private sector participation, in building, owning, operating, leasing and transferring of water resources facilities, may be considered.

Water Quality

14.1 Both surface water and ground water should be regularly monitored for quality. A

phased programme should be undertaken for improvements in water quality.

14.2 Effluents should be treated to acceptable levels and standards before discharging them into natural streams.

14.3 Minimum flow should be ensured in the perennial streams for maintaining ecology and social considerations.

14.4 Principle of 'polluter pays' should be followed in management of polluted water.

14.5 Necessary legislation is to be made for preservation of existing water bodies by preventing encroachment and deterioration of water quality.

Water Zoning

15. Economic development and activities including agricultural, industrial and urban development, should be planned with due regard to the constraints imposed by the configuration of water availability. There should be a water zoning of the country and the economic activities should be guided and regulated in accordance with such zoning.

Conservation of Water

16.1 Efficiency of utilisation in all the diverse uses of water should be optimised and an awareness of water as a scarce resource should be fostered. Conservation consciousness should be promoted through education, regulation, incentives and disincentives.

16.2 The resources should be conserved and the availability augmented by maximising retention, eliminating pollution and minimising losses. For this, measures like selective linings in the conveyance system,

modernisation and rehabilitation of existing systems including tanks, recycling and re-use of treated effluents and adoption of traditional techniques like mulching or pitcher irrigation and new techniques like drip and sprinkler may be promoted, wherever feasible.

Flood Control and Management

- 17.1 There should be a master plan for flood control and management for each flood prone basin.
- 17.2 Adequate flood-cushion should be provided in water storage projects, wherever feasible, to facilitate better flood management. In highly flood prone areas, flood control should be given overriding consideration in reservoir regulation policy even at the cost of sacrificing some irrigation or power benefits.
- 17.3 While physical flood protection works like embankments and dykes will continue to be necessary, increased emphasis should be laid on non-structural measures such as flood forecasting and warning, flood plain zoning and flood proofing for the minimisation of losses and to reduce the recurring expenditure on flood relief.
- 17.4 There should be strict regulation of settlements and economic activity in the flood plain zones along with flood proofing, to minimise the loss of life and property on account of floods.
- 17.5 The flood forecasting activities should be modernised, value added and extended to other uncovered areas. Inflow

forecasting to reservoirs should be instituted for their effective regulation.

Land Erosion by Sea or River

- 18.1 The erosion of land, whether by the sea in coastal areas or by river waters inland, should be minimised by suitable cost-effective measures. The States and Union Territories should also undertake all requisite steps to ensure that indiscriminate occupation and exploitation of coastal strips of land are discouraged and that the location of economic activities in areas adjacent to the sea is regulated.
- 18.2 Each coastal State should prepare a comprehensive coastal land management plan, keeping in view the environmental and ecological impacts, and regulate the developmental activities accordingly.

Drought-prone Area Development

- 19.1 Drought-prone areas should be made less vulnerable to drought-associated problems through soil moisture conservation measures, water harvesting practices, minimisation of evaporation losses, development of the ground water potential including recharging and the transfer of surface water from surplus areas where feasible and appropriate. Pastures, forestry or other modes of development which are relatively less water demanding should be encouraged. In planning water resource development projects, the needs of drought-prone areas should be given priority.
- 19.2 Relief works undertaken for providing employment to drought-stricken population

should preferably be for drought proofing.

Monitoring of Projects

- 20.1 A close monitoring of projects to identify bottlenecks and to adopt timely measures to obviate time and cost overrun should form part of project planning and execution.
- 20.2 There should be a system to monitor and evaluate the performance and socio-economic impact of the project.

Water Sharing / Distribution amongst the States

- 21.1 The water sharing / distribution amongst the states should be guided by a national perspective with due regard to water resources availability and needs within the river basin. Necessary guidelines, including for water ShOti states even outside the basin, need to be evolved for facilitating future agreements amongst the basin states.
- 21.2 The Inter-State Water Disputes Act of 1956 may be suitably reviewed and amended for timely adjudication of water disputes referred to the Tribunal.

Performance Improvement

22. There is an urgent need of paradigm shift in the emphasis in the management of water resources sector. From the present emphasis on the creation and expansion of water resources infrastructures for diverse uses, there is now a need to give greater emphasis on the improvement of the performance of the existing water resources facilities. Therefore, allocation of funds under the water resources sector should be re-prioritised to ensure that the needs for development as well as operation and maintenance of

the facilities are met.

Maintenance and Modernisation

- 23.1 Structures and systems created through massive investments should be properly maintained in good health. Appropriate annual provisions should be made for this purpose in the budgets.
- 23.2 There should be a regular monitoring of structures and systems and necessary rehabilitation and modernisation programmes should be undertaken.
- 23.3 Formation of Water Users' Association with authority and responsibility should be encouraged to facilitate the management including maintenance of irrigation system in a time bound manner.

Safety of Structures

24. There should be proper organisational arrangements at the national and state levels for ensuring the safety of storage dams and other water-related structures consisting of specialists in investigation, design, construction, hydrology, geology, etc. A dam safety legislation may be enacted to ensure proper inspection, maintenance and surveillance of existing dams and also to ensure proper planning, investigation, design and construction for safety of new dams. The Guidelines on the subject should be periodically updated and reformulated. There should be a system of continuous surveillance and regular visits by experts.

Science and -Technology

25. For effective and economical management of our water resources, the frontiers of

knowledge need to be pushed forward in several directions by intensifying research efforts in various areas, including the following:

- hydrometeorology;
- snow and lake hydrology;
- surface and ground water hydrology;
- river morphology and hydraulics;
- assessment of water resources;
- water harvesting and ground water recharge;
- water quality;
- water conservation;
- evaporation and seepage losses;
- recycling and re-use;
- better water management practices and improvements in operational technology;
- crops and cropping systems;
- soils and material research;
- new construction materials and technology (with particular reference to roller compacted concrete, fiber reinforced concrete, new methodologies in tunneling technologies, instrumentation, advanced numerical analysis in structures and back analysis);
- seismology and seismic design of structures;
- The safety and longevity of water-related structures;
- economical designs for water resource projects;
- risk analysis and disaster management;
- use of remote sensing techniques in development and management;
- use of static ground water resource as a crisis management measure;
- sedimentation of reservoirs;
- use of sea water resources;
- prevention of salinity ingress;
- prevention of water logging and soil salinity;
- reclamation of water logged and saline lands;
- environmental impact;
- regional equity.

Training

26. A perspective plan for standardised training should be an integral part of water resource development. It should cover training in information systems, sectoral planning, project planning and formulation, project management, operation of projects and their physical structures and systems and the management of the water distribution systems. The training should extend to all the categories of personnel involved in these activities as also the farmers.

Conclusion

27. In view of the vital importance of water for human and animal life, for maintaining ecological balance and for economic and developmental activities of all kinds, and considering its increasing scarcity, the planning and management of this resource and its optimal, economical and equitable use has become a matter of the utmost urgency. Concerns of the community needs to be taken into account for water resources development and management. The success of the National Water Policy will depend entirely on evolving and maintaining a national consensus and commitment to its underlying principles and objectives. To achieve the desired objectives, State Water Policy backed with an operational action plan shall be formulated in a time bound manner say in two years. National Water Policy may be revised periodically as and when need arises. ■

(Source: nic.gov.in)



The State of Rajasthan is the second largest state in the country covering an area of 34.271 Million ha which is more than 10% of the total geographical area of the country. About 5% of the total population of the country resides in the state and it has more than 15.7 million ha of land suitable for agriculture. The State of Rajasthan is one of the driest states of the country and the total surface water resources in the state are only about 1% of the total surface water resources of the country. The rivers of the state are rainfed and identified by 14 major basins divided into 59 subbasins.

The surface water resources in the state are mainly confined to south and south-eastern parts of the State. There is a large area in western part of the state which does not have any defined drainage basin. Thus the water resources in the state are not only scarce but have highly uneven distribution both in time and space.

PROPOSED WATER POLICY OF RAJASTHAN

1. The Need for a State Water Policy

Water is a prime natural resource, a basic human need and a precious asset of the State. Planning, development, operation and maintenance of all water resources to support the growth of the state economy and the well being of the population, in response to the growing need for drinking water, agricultural products, industrial production and electricity, a general improvement of living conditions and employment is of utmost importance. Planning and development of water resources need to be governed by the state's perspectives. The requirement of utilising all available water resources, surface and ground, in a judicious and equitable, as well as sound economic manner needs a well defined **State Water Policy**.

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The surface water resources in the state are mainly confined to south and south-eastern parts of the State. There is a large area in western part of the state which does not have any defined drainage basin. Thus the water resources in the state are not only scarce but have highly uneven distribution both in time and space. The ground water also plays an important role especially in agriculture and drinking water supply. The situation of ground water exploitation is also not satisfactory as in

areas where surface irrigation is provided there is a tendency of not using ground water for agriculture which creates problem of water table rise and even water logging. On the contrary, in large areas of the State, ground water is being over exploited and the water table in some areas is going down even at the rate of 3 metre per year. This background leads to the formulation of the following water resources development and management objectives:

- a. Development of all utilisable water resources to the maximum possible extent, including surface water - local and imported - groundwater and waste water, for optimal economic development and social well-being.
- b. Assuring an integrated and multidisciplinary approach to planning, evaluation, approval and implementation of irrigation and drainage projects, including river basin management, of surface and ground water.
- c. Optimisation of water resources

exploitation and raising the level of reliability of supplies through conjunctive use of surface and ground water.

- Judicious and economically sound allocation of water resources to different sectors, with drinking water supply as a first priority.
- Optimum utilisation of water resources to maximise production in all user sectors.
- Providing flood protection and drainage facilities, as well as assuring minimal supplies during drought periods.
- Maintenance of water quality at acceptable standards and reduction of water resources' pollution by urban and industrial sewage.
- Ensuring proper functioning of existing structures, conveyance systems and other assets through adequate maintenance and operation.
- Minimising adverse impacts of water resources development on the natural environment and on population affected by project implementation works.
- Promoting beneficiaries' participation in all aspects of water planning and management, with particular emphasis on Water User Associations intended to manage and maintain irrigation systems, both physically and financially.
- Motivating and encouraging water conservation through appropriate and socially acceptable water rates, introduction of water-saving devices and practices in all sectors, and educational campaigns.
- Advancing the technological and scientific level of all the staff in the water sector through intensification of applied research, technology transfer, training and education.
- Ensuring well coordinated and efficient decision making, planning, design, execution and operation and maintenance activities among all GOR

agencies.

- Facilitating private initiative in development, operation and management of water projects.
- Emphasis to be given for recharge of ground water aquifers to mitigate the crisis of drinking water supply and demand of drinking water supply and for industrial and other purposes.

2. Information System

The prime requisite for resources planning is a well developed information system. There should be free exchange of data among the various agencies and duplication in data collection should be avoided. Timely availability of reliable information, conveniently accessible to all users, is necessary as a tool for integrated planning of new projects, and for following up the performance of existing systems and the status of water resources. Following actions shall be taken in this regard:

- Setting up of a central information center for the entire water sector of Rajasthan.
- Clear definition of duties and responsibilities of those charged with data collection.
- Detailing of main reports to be generated.

3. Maximizing Water Availability

Due to the high variability of hydrometeorological phenomena not all the potentially available resources can be harnessed and made utilisable. The overwhelming interest of the State is to bring, by physical and managerial measures, as much of the potentially available resources into beneficial utilisation as is physically and economically feasible. The resources shall be conserved and the availability for use augmented by measures for maximising retention and minimising losses. Following actions shall be taken for maximising water availability:

- Comprehensive and integrated water resource planning shall be done for the State on the basis of

hydrological units i.e. basin or a sub-basin.

- Water resources potentials, both surface and ground, shall be assessed.
- Basin-wise and State-level water resources development and
- Water resources development projects shall be prioritised on economic, social and financial criteria to aid in budget allocation.
- Waste water reclamation shall be considered in all basin plans.
- Efficient water application and utilisation practices shall be encouraged.
- A **Central Planning Authority** for policy related issues for integrated water resources development and management shall be created.
- Traditional water harvesting practices shall be preserved and encouraged.
- Projects for artificial recharge of ground water shall be prepared.
- Inter basin transfer projects shall be prepared based on a State-wide perspective, after taking into account the requirements within the basins.
- The case for full utilisation of State's share in Ganga waters shall be pursued.

4. Project Planning

Water resources development planning shall aim at assuring accelerated growth by contributing to the State's economic and social advancement, and improving the general social and economic conditions of the population, while keeping the environmental and ecological balance. The State Water Policy shall be reflected in all plans recommended for implementation. Special attention shall be given to the non-structural elements of this policy, aimed at achieving the objectives of reduction of poverty, basic food self-sufficiency, overall economic growth, environmental well-being, progress of weaker sections of the population, etc.

Water resource development projects shall as far as possible be planned and developed as comprehensive and multi-purpose projects. All present and predictable

future demands, including irrigation, domestic and livestock demand, industries, thermal and hydroelectric power stations, pisciculture and recreation, and all sources of natural water as well as reclaimed wastewater must be considered. Provision for drinking water shall be a primary consideration. The study of the impact of a project, during its construction period as well as during its operational life, on human lives, settlements, occupations, economic and other social aspects, shall be an essential component of project planning. Time and cost overruns and deficient realisation of benefits characterising most irrigation projects shall be overcome by upgrading the quality of project preparation and management. The under-funding of projects shall be obviated by an optimal allocation of resources, having regard to the early completion of ongoing projects as well as the need to reduce regional imbalances. The following institutional and procedural reforms and manpower development in projects shall be carried out:

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Institutional Reforms:

- a. Integrated long and short term planning of water resources development.
- b. Economic analysis and feasibility studies of projects.
- c. Monitoring and evaluation of existing projects.

- d. Drafting annual and multi-annual expenditure programmes for the entire water sector and obtaining approval.
- e. Encourage private initiative in water sector.

Human Resources Development:

- a. Introduce training courses and professional career incentives, and foster professional dedication, with emphasis on client management.

Procedural Reforms:

- a. Improvement in process of project planning, sanctioning, bidding, etc.
- b. Define accountability and authority.
- c. Define information flow routes and access to data.
- d. Establish guidelines for priority in public spending in water sector.

5. Maintenance and Modernisation

For maintaining the existing structures and systems in satisfactory condition and timely modernisation, the following actions shall be taken:

- a. A adequate budget for maintenance, repair, modernisation of existing structures and systems shall be allocated.
- b. Water rates shall be increased and collections shall be improved.
- c. Orders and instructions for inspections / reporting of maintenance, repair and replacement works shall be issued.
- d. Maintenance oriented training programmes shall be undertaken.
- e. Water User Associations shall be encouraged to undertake maintenance, repairs and modernisation of works.

6. Safety of Structures

The Dam Safety Organisation shall be reinforced and supported, at State level, for ensuring the trained staff in improved inspection, analysis and evaluation techniques of dams and other structures. Guidelines issued by State authorities on the subject shall be kept under constant review and

periodically updated and re-formulated Dam Safety Legislation may be enacted to ensure proper inspection, maintenance and surveillance of existing dams and also to ensure proper planning, investigation, design and construction for safety of new dams.

7. Groundwater Development

Exploitation of groundwater resources should be so regulated as not to exceed recharging possibilities, and also to ensure social equity. There should be a periodical reassessment on a scientific basis of groundwater potentials, taking into consideration the quality of the water available and economic viability. Following steps shall be taken in this regard:

Legal : Existing laws shall be amended /new legislation shall be enacted.

Organisational : Organisational structures and procedures shall be changed. Attempt to control deep drilling through licensing and control on private operators shall be made. on private operators shall be made.

Social: Public awareness for self-control in ground water exploitation from WUAs shall be fostered.

Educational: Sense of water scarcity and need to conserve shall be developed.

Technological : Data collection shall be improved, conjunctive use of ground and surface water shall be planned, mathematical modeling of aquifer shall be done and artificial recharge of ground water shall be planned.

Environmental : The detrimental environmental consequences of over exploitation of ground water need to be effectively prevented.

8. Water Allocation Priorities

In the planning and operation of systems, water allocation priorities shall be to Drinking water, Irrigation, Power generation and Industrial and other uses in that order. However, these priorities might be modified if necessary in particular regions with reference to area specific considerations, and they may be different in the context of allocating water to existing consumers than in the context of planning the development of water resources for new consumers. A

detailed methodology for multi-priority analysis shall be developed for decision making in the Central Planning Authority to enable prioritisation in water resources planning and management. The demands of drinking water, irrigation, power generation, industrial and other uses shall be studied scientifically for appropriate development and allocation of funds.

9. Drinking Water

Adequate drinking water facilities shall be provided to the entire population both in urban and in rural areas. Future irrigation and multipurpose projects shall invariably include a drinking water component wherever there is no dependable alternative source of drinking water. Drinking water needs of human beings and animals shall be the first charge on any available water and following actions shall be taken to fulfill this need: and animals shall be the first charge on any available water and following actions shall be taken to fulfill this need:

- a. Increased budget shall be allocated for upgrading urban and rural domestic and livestock water supply.
- b. Water rates shall be gradually increased to self-support the operation of urban and rural piped schemes.
- c. Finance of rural water supply schemes shall be continued.
- d. Water quality standards shall be ensured.
- e. Strict control over activities which endanger sources such as hazardous wastes and sewage shall be exercised.
- f. Privatisation in urban water supply especially for meter reading, billing etc. can be contracted out.

10. Irrigation Water

Irrigation planning, either in an individual project or in a basin as a whole, should take into account the irrigability of land, cost-effective irrigation options possible from all available sources of water, and appropriate irrigation and drainage techniques. The irrigation intensity should be such as to extend the benefits of irrigation to as large as number of farm families as possible, keeping in view the need to maximise production. Following measures shall be taken to ensure that the irrigation potential

created is fully utilised, the gap between the potential created and its utilisation is removed, water allocation in an irrigation system is done with due regard to equity and social justice, disparities in the availability of water between head-reach and tail-end farms and between large and small farms should be obviated by adoption of a rotational water distribution system, supply of water on a volumetric basis subject to certain ceilings is introduced and there is close integration of water-use and land-use policies. To achieve these objectives a multidisciplinary and integrated approach will be followed under C.A.D. programme.

- a. It shall be ensured that the Government regulations are adhered to by law and persuasion.
- b. Farmers shall be encouraged to adopt high efficiency water equipments and practices and use of ground water in conjunction with surface water.
- c. Water charges shall be reviewed and realistic water rates shall be introduced.
- d. Reclamation of waterlogged / saline affected land by scientific methods should form a part of command area development programme.

11. Water Rates

Water rates shall be so decided that it conveys the scarcity value of water to users and foster the motivation for economy in water usage. Rates shall be gradually increased to cover the annual maintenance and operation charges and part of the fixed costs to assure undisturbed and timely supply of irrigation water. Water rates shall be rationalised with due regard to the interests of small and marginal farmers. It shall be accompanied by volumetric measurement of water consumption in all sectors.

12. Participation of Water Users

Farmers shall be involved in various aspects of management of irrigation systems, particularly in water distribution and collection of water charges through following measures:

- a. Evaluating results of on-going pilot projects where farmers' participation has been introduced.
- b. Introducing changes in legislation

for fostering user participation in irrigation.

- c. Giving priority of funds for rehabilitation and modernisation of irrigation projects to those projects where farmers are willing to organise into WUAs.
- d. Assistance of voluntary agencies shall be taken in educating the farmers in efficient water use and water management.

13. Water Quality Monitoring

Both surface water and ground tistics and maps for River Basins. Proposals for contracting the work of water sampling and analysis to private water as well as soil quality shall be regularly monitored for quality and a phased program shall be undertaken for improvements in water quality. Government shall issue orders to routinely enter future water and soil quality figures in the water resources database and publish groundwater statistics and maps for River Basins. Proposals for contracting the work of water sampling and analysis to private operators will be studied. Effluents should be treated to acceptable levels and standards before discharging them in natural streams. Minimum flow should be ensured in the perennial streams for maintaining ecology and social considerations.

14. Water Zoning

15. Water Conservation and Efficiency of Utilization.

The efficiency of utilisation in all the diverse uses of water should be improved and an awareness of water as a scarce resource should be fostered. Conservation consciousness shall be promoted through education, regulation, incentives and disincentives by taking following actions:

A. Domestic Sector:

- Introduction of domestic water saving devices
- Water meters on all consumers.
- Progressive water tariff structure.
- Auditing of water balance from distribution systems. etc...

B. Industrial sector:

- Progressive water tariff.
- Water recycling facilities.
- Treated urban sewage water for

cooling and other processes.

C. Agriculture Sector:

- Water rates on volumetric basis should be kept sufficient for
- Saline water for tolerant crops.
- Improvement in irrigation practices and reduction of water losses.
- Pressure irrigation systems to be introduced

D. Watershed management for each basin:

- Afforestation, soil conservation.
- Livestock management.
- Treatment and disposal of sewage. Every drop of water needs to be conserved and optimally utilised for which detailed scheme shall be framed ensuring its time bound implementation.

16. Flood Control and Drainage Management

Sound watershed management through extensive soil conservation, catchment area treatment, preservation of forests and increasing the forest area and construction of check dams shall be promoted to reduce the intensity of floods. Adequate flood cushion shall be provided in water storage projects whenever feasible to facilitate better flood management. An extensive network for flood forecasting shall be established for timely warning to the settlements in the flood plains, along with the introduction of regulation for settlements and economic activity in the flood-prone zones to minimise loss of life and property caused by floods. Master plan for flood control and management for each flood prone basin / area shall be got prepared. Due consideration to provide proper drainage shall also be given to build up capabilities to tackle water logging and salinity problems.

17. Drought Management

Drought prone areas shall be made less vulnerable to drought associated problems through measures listed below. In planning water resource development projects, the needs of drought prone areas should be given priority. Relief works undertaken for providing employment to drought stricken populations should preferably be for drought proofing.

- a. Continue efforts to assure water supply and livelihood to population and care for livestock.

- b. Employment and direct provision of basic needs to population in times of crisis.
- c. Drought-proofing of the area in measures such as plantation, dry farming.
- d. Development of training and skills to enable population to supplement the earnings from agriculture.
- e. Development of the ground water potential including recharging and the transfer of surface water from surplus areas wherever feasible and appropriate.

18. Training and Education.

Standardised training shall be a part of water resources management and should cover all its aspects and all personnel involved in it, including farmers. The State shall also encourage education of the public at large.

Scholarships, study tours, incentives etc. shall be provided by the State to encourage and support training. Technology transfer shall be made obligatory on all technical assistance and consulting services. Emphasis on research on all matters related to water management shall also be given.

19. Legislation and Regulation

After a critical examination of rules, regulations, ordinances, legal and legislative measures related to the State's water sector has been made, with a view to improve and streamline their scope and cover in the legal framework all aspects pertaining to water resources management, protection of water quality, flood protection, drought proofing, abstraction licensing, water rights, etc. the Government shall introduce the following measures:

- a. Enact the necessary amendments and additions to existing Act, rules, regulations, orders, decisions, etc.;
- b. Ensure that the responsibilities and powers of Governmental agencies and the rights and obligations of individuals be clearly spelled-out in the relevant laws and regulations;
- c. Ensure that the legislation would allow for easy implementation of policy decisions while protecting the interests of individuals and taking into account the administrative capacity to implement them;
- d. Empower the appropriate agencies to carry out their obligations and responsibilities as implied by the

nated, equitable and efficient control, as well as the resolution of conflicts which may arise from them; public ownership of water projects, and spell out the administrative procedures necessary for coordinated, equitable and efficient control, as well as the resolution of conflicts which may arise from them;

- e. Provide legal support for the formation of WUAs and handing over to them the distribution of water for irrigation and the maintenance of canals;

- f. Establish rules and regulations for the involvement of the private sector in development and operation of water-related projects;

- g. Provide in the law for an effective participation of farmers in the planning and decision making processes which involve users and public authorities;

- h. Introduce the necessary legislation for a periodic amendment of water rates and tariff structures which would enable the full coverage of O&M expenditures, based, as far as possible on volumetric metering of supplies, while motivating users to economise in the use of water, and catering for the weaker sections of the population;

- i. Establish effective conflict resolution legal entities and procedures. The entire body of water-related laws and regulations will eventually be amalgamated into a State Water Law, which would, in addition to the above mentioned subjects, establish the State ownership of all the water resources within the State, as well as waters imported from outside the State under various agreements, and the requirement for any public or private entity or individual to obtain from the Government a permit to abstract surface water or groundwater, to utilise it, to sell or distribute it, or to dispose off after use. Permitting and enforcement rules and regulations will be spelled-out accordingly. ■

(Source: Water Resource Department, GOR)

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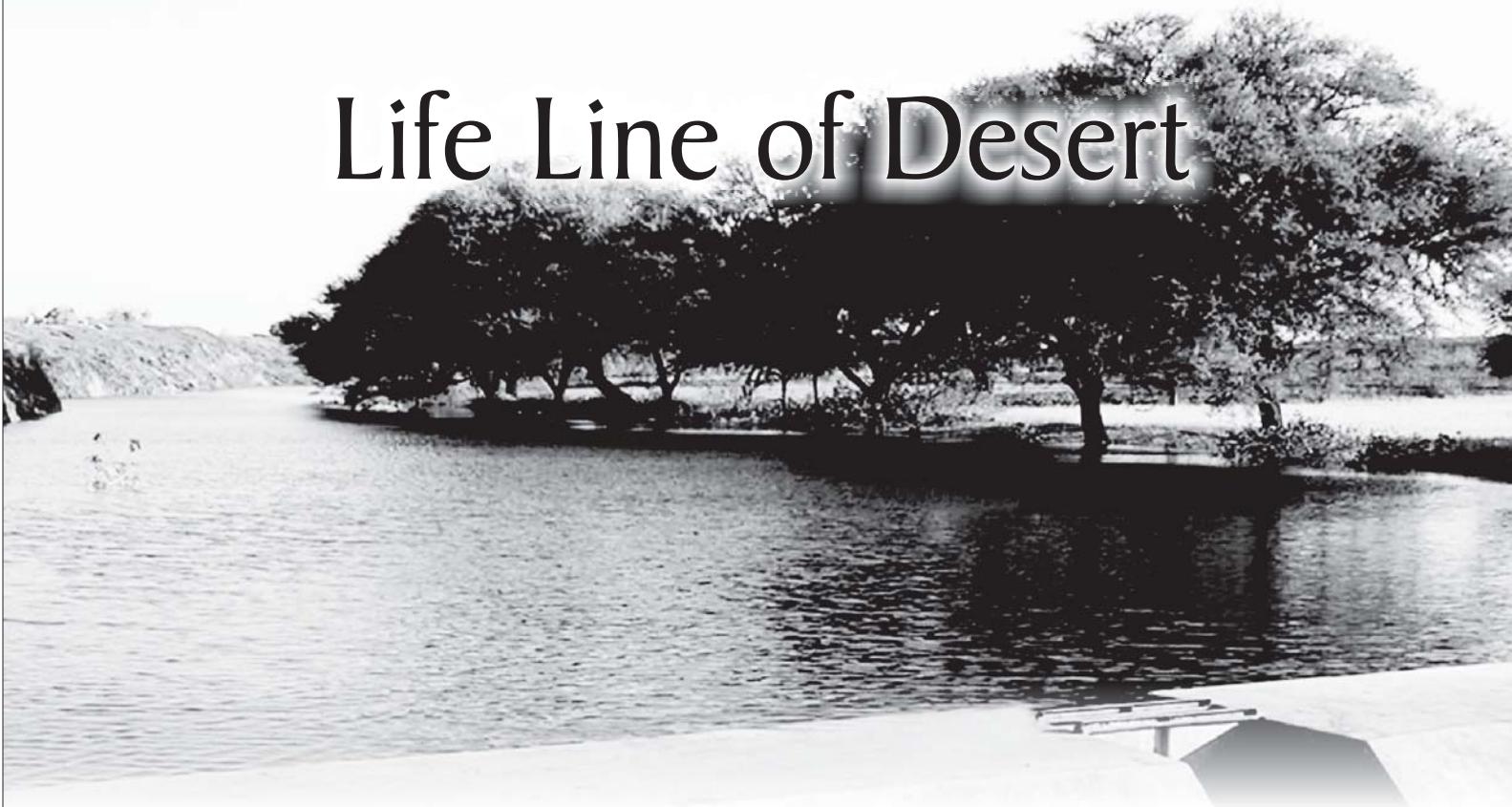
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Life Line of Desert



Indira Gandhi Canal is one of the biggest canal projects in India and perhaps in the world too. It starts from the Harike Barrage, a few kilometers below the confluence of the Sutlej and Beas rivers in Punjab state. It runs south-southwest in Punjab and Haryana but mainly in Rajasthan for total 650 kilometers and terminates near Jaisalmer, in Rajasthan.

Its construction started in 1958. It is built with the aim to convert the part of Thar desert from wasteland to agriculturally productive area. It was earlier known as Rajasthan Canal. The name was changed in 1984.

It uses water released from Pong dam and will provide irrigation facilities to the north-western region of Rajasthan, i.e., a part of the Thar Desert. It consists of Rajasthan feeder canal (with the first 167 km in Punjab and Haryana and the remaining 37 km in Rajasthan) and 445 km in Rajasthan main canal entirely in Rajasthan. Green revolution in Rajasthan After completion of Indira Gandhi Canal, irrigation facilities would be available in an area of 6770 km² in Jaisalmer district

and 37 km² in Barmer district. Irrigation facility has already been provided in an area of 3670 km² in Jaisalmer district. The canal has transformed the barren deserts of Jaisalmer district into rich and lush fields. Crops of mustard, cotton and wheat now flourish in the semi-arid western region of the state where nothing but sand ruled the roost for years.

Indira Gandhi canal has transformed northern part of Arid Rajasthan into Green and Granary. It seems to be changing the face of Rajasthan's deserts. Improvement in living standard Besides providing water for the crops, the canal would supply drinking water to hundreds of people in the far-flung areas. As the second stage of work on the canal progresses rapidly, there is hope that it will enhance the living standards of the people of the state. Sand dune stabilization Indira Gandhi Canal is a major step to reclaim the Thar Desert and check spreading of desert to the fertile areas. Planting programme for greening the desert in Indira Gandhi Canal areas were started in 1965 by way of planting of

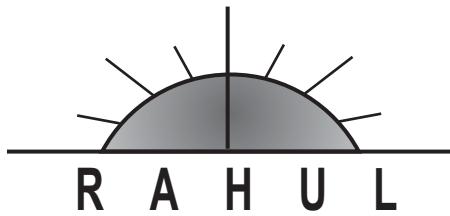
shelterbelts along roads and canals, block plantations and sand dune stabilization to check the spread of desert.

The tree species being used for planting are *Dalbergia sissoo*, *Eucalyptus tertiornis*, *Eucalyptus camaldulensis*, *Morus alba*, *Tecomella undulata*, *Acacia tortilis*, *Azadirachta indica*, *Albizia lebbeck*, *Cassia fistulata*, *Popular ciliata*, *Melia azedarch*, and *Acacia nilotica*. Environmental problems The excessive irrigation and intensification of agriculture over the years has caused environmental degradation and creation of new wastelands. Waterlogging problem has caused due to excessive irrigation, seepage from canals and lack of drainage.

These factors resulted into the rise of water table, then development of salinity and finally the submergence of the land. Salinisation has also been resulted due to cultivation of more water requiring crops like wheat and rice for economic gains. ■

Jitendra Tiwari

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Presence of NGO

The presence and role of voluntary organizations in social development has become manifold large and multidimensional in last couple of decades. There has been a golden history of voluntary movement in the state. However, there are some historically backward areas in terms of presence and outreach of voluntary initiatives. Vidya Bhawan Society and Seva Mandir in Udaipur, Social Work Research Centre in Ajmer and Urmul in Bikaner are some good examples to understand the evolution and development of the sector in the state.

Role of NGO

Efforts done by voluntary agencies are widely recognized, accepted and have been instrumental in bringing the disadvantaged into the development mainstream. Today the voluntary agencies are playing a major role in awareness building, organizing communities, trainings, service delivery, initiating innovations in development, research, planning, monitoring and policy reforms. These roles are being performed in key sectors like - Rural Development, Health and Family Welfare, Social Welfare, Micro-credit and Livelihoods, Natural Resource Management (Water, Forest, Agriculture and Animal Husbandry), Education, Women Development, Relief & Disaster Management, Social Security and Empowerment of disadvantaged people and so on.

Departmental Support

GO-NGO collaboration and partnership has now become an established phenomenon in development sphere. Some of the projects where involvement of NGOs is being sought by various departments are DP1P, SGSY, Rashtriya Sam Vikas Yojana, Innovative scheme for rural housing and habitat program, Day

Care Center, Old and Destitute Home, Short Stay Homes, Balgrah Centers for destitute children, Swayam Siddha, ICDS, Balika Samridhi Yojana, National Aids Control Programme, Targeted Intervention, School Aids Education Vaccination camps, Reproductive and Child Health (RCH), Camps under Blindness Control Program, Pulse Polio Program, Rajasthan Water Sector Restructuring Project, Rajasthan Forestry and Bio-diversity project, Apni Yojana, National Slum Development Program, Swarna Jayanti Shahri Rozgar Yojana etc.

A variety of initiatives are being undertaken for environment protection particularly water. The State Government has taken a number of initiatives to strengthen voluntary sector and to promote GO-NGO collaboration. Efforts are also being made by the state to build capacities of voluntary organizations. Specific actions taken in this regard are as under:-

ARAVALI

Association for Rural Advancement through Voluntary Action and Local Involvement (ARAVALI) is set up by the state for advancement of the voluntary movement in the state, as a state level resource support organization, ARAVALI puts in its efforts to build capacities of voluntary agencies in general and small and medium sized voluntary organizations in particular. It also advocates for a facilitative environment for GO-NGO collaboration. It also helps voluntary organizations to undertake innovations in development interventions.

Setting Up of NGO Cell

The Government has set up an NGO Cell as state level ernment

collaborative machinery to institutionalize GO-NGO collaboration. State Level joint machinery in the form of Standing Committee has been constituted under the Chairmanship of the Development Commissioner with equal representation from NGOs, VOs and PRIs so as to ensure better coordination between the Government Departments and VOs/NGOs.

District level GO-NGO-PRI forum

For effective collaboration, building mutual understanding, appreciation, acceptance, trust and shared learning between the Government, NGOs and PRIs is a necessity. To fulfill this objective district level forum has been initiated to facilitate regular interaction and dialogue between the Government, NGOs and PRIs for participatory development at the field level by harnessing strengths of all agencies. Efforts are being made by ARAVALI to make these forums operational in three districts namely Dholpur, Baran and Jhalawar on pilot basis.

Procedures and Guidelines

The Government has developed draft procedures and guidelines for involving NGOs/VOs in Government programmes. The criteria and procedures for involvement of VOs would facilitate meaningful public- private partnership. The guidelines focus on selection criteria, procedures, terms and condition of the partnership. The initiative has been taken up mainly by the Rural Development Department and the Irrigation Department.

Medical & Health Department has a NGO desk, to facilitate effective communication between the Government and NGOs. Some government departments have also appointed NGO advisors to deal with matters related to NGOs. ■

■ Seema Chawla

GOVERNMENT OF RAJASTHAN WATER RESOURCES DEPARTMENT

No.: F()SWRPD/F.54 Jaipur

Dated – 14.02.2007

NOTIFICATION

The State Government hereby issues the following guidelines for involving Non Government Organizations (NGO) / voluntary organizations in water related activities / projects:

1. BACKGROUND

The past three decades have witnessed the emergence of Voluntary Organizations (VOs)/ Non Governmental Organizations (NGOs) playing a significant role in development in the country. In India, central and state governments, agencies such as the Planning Commission have given due recognition to the role of civil society organizations. Since public participation is essential in the critical water resource development activities, NGOs, which are close to people, could play a pivotal role in mobilising and organising them.

Objective criteria for selection of NGOs as partner, a transparent procedure and a good (clear and based on principle of partnership) agreement between Government and NGOs/VOs can surely lead to a healthy partnership.

2. OBJECTIVE

- 2.1 To involve NGOs / VOs in water related activities / projects. These guidelines would not be applicable in cases where specific guidelines exist for involving NGOs / VOs in different programmes / schemes of Government of India.
- 2.2 To institutionalize partnership of Government with NGOs/ VOs and increase community participation in the ongoing, new and proposed activities.'
- 2.3 To generate a sense of ownership among the users.
- 2.4 To allow freedom in activities and innovative methods in approach.
- 2.5 To evolve in-built provisions and mechanisms for conflict resolution.
- 2.6 To prepare community to take responsibilities, in other words, the activity should start only when the community is prepared to play its role and assume responsibilities.
- 2.7 To institutionalise collaboration among Government, NGOs and user groups with specific roles and responsibilities.

3. SCOPE

NGOs could be effective in the following areas, based on their experience, track record and professional competence:

- 3.1 For awareness building in communities.
- 3.2 Creation/ construction/ rehabilitation of works related to water conservation, harvesting, irrigation, artificial recharge of ground water, distribution of water for irrigation, domestic, industrial and other uses.
- 3.3 To carry out survey, investigation (including sub-surface), planning, design, development and management of all water sector programmes being implemented by water related departments.
- 3.4 Organising village institutions/user groups in the management of schemes related to water sector.
- 3.5 Assessment of all water resources and demands and preparation of integrated water resources plans for demand management.
- 3.6 Integration of information from various sources.
- 3.7 Information, Education and Communication (IEC).
- 3.8 Mobilising communities in water sector, including capacity building and institutional strengthening etc of water user groups to take over the maintenance, water distribution and revenue collection. This will inculcate a sense of ownership among them for sustainable development.
- 3.9 Water treatment and disposal of hazardous waste.
- 3.10 Design, execution and management of minor irrigation projects such as tanks, lift irrigation systems, including drinking water projects.
- 3.11 Monitoring and documentation of projects.

4. SELECTION CRITERIA FOR INVOLVING NGOs / VOs

4.1 Eligibility

- 4.1.1 NGO/VO should be registered under Societies Registration Act/ Cooperative Act/ Charitable and Religious Trust Act 1920/ Indian Companies Act, 1950 (Section 25). Works will be awarded to NGO / VO registered as above only.
- 4.1.2 NGO / VO should be registered wherever required under Income Tax Act and should also quote the PAN Number.
- 4.1.3 Registration under FCRA in case of projects involving foreign funding.

4.2 Management Committee and Board of Trustees

- 4.2.1 Adherence to provision of constitution of management Committee / Board of Trustees in the byelaws should be verified. The Management Committee should have clear roles and responsibilities and should have regular meetings as per the bylaws.
- 4.2.2 The CEO or the members of the management committee should not be convicted in any criminal case.
- 4.2.3 Organization should not have more than two close relatives in board i.e. Father, Mother, Children, Husband, Wife, Brother, Sister. Subject further to the condition that number of close relatives in the board should be less than 50%.
- 4.2.4 It is apolitical and secular in nature. It should not be working for a particular caste/ creed/ religion.

4.3 Exclusions

The following organizations would not be empanelled:

- 4.3.1 Those lacking legal status in terms of registration under Societies Registration Act/Co-operative Act/Charitable and Religious Trust Act 1920/Public Charitable Trust Act/Section 25 of the Companies Act (1950). Organizations not registered although required to be registered under the Income Tax Act would also be excluded. NGOs not registered under FCRA would be excluded from projects involving foreign funding.
- 4.3.2. Organizations black listed by any state and central government department / agency.
- 4.3.3. Organizations whose office-bearers have been convicted of any criminal offence
- 4.3.4 Organizations with poor track record in terms of time overrun and/or under performance and unsatisfactory work in any manner.
- 4.3.5 CEO of the concerned NGO / VO should not have been penalised or involved in any criminal case.

4.4 Information to be furnished by NGOs

- 4.4.1. Constitution/Memorandum of Association.
- 4.4.2. Legal status, along with certified copies of registration certificates under Societies Registration Act/Co-operative Act/Public Charitable and Religious Trust Act (1920)/ Section 25 of Companies Act (1950), and if applicable, registration under Income Tax Act and FCRA.
- 4.4.3. Lists with occupation and addresses of office bearers/board of trustees/governing council members with the dates of association and relationship with other office bearers/trustees. Not more than two trustees/governing council members should be related to each other.
- 4.4.4. Audited accounts of preceding three years.
- 4.4.5. List of assets and liabilities duly certified by C.A..
- 4.4.6. Annual reports of activities of preceding three years, with specific details of water sector achievements.
- 4.4.8. List of experts with qualifications, experience and last assignment/employment on panel.
- 4.4.9. A short write up on the founder(s)' purpose, vision, mission and goals of the organization.
- 4.4.10. Record of criminal conviction and pending cases, against the office bearers, if any (The Chairman / President/ Head or Members of the Governing Body / Executive Body of the NGO/VO should not have been convicted under any criminal case by any court of law in the country.)
- 4.4.11. Details of the cases pending in any court of law against the Chairman / President/ Head or Members of the Governing Body / Executive Body of the NGO/VO.
- 4.4.12. Desired category general / professional.
- 4.4.13. Details of blacklisting or penal action taken in the past by any government or international agency of the CEO

of the NGO/VO or NGO/VO, if any.

4.4.14 Certificate of performance from previous agency or evaluation report(s) of previous projects implemented, particularly, from independent agencies.

4.4.15 If the NGO/VO is registered under Foreign Contributions Regulation Act (FCRA) the same should be disclosed with details pertaining to receipt of funds in the past and activities carried out using these funds.

4.4.16 The NGO / VO should furnish details of ongoing works/activities with them.

5. EXPERIENCE

5.1 Project Implementation

5.1.1 The organization should have an experience of minimum 3 years after registration in the relevant activity.

5.1.2 The organization should have ability to plan, implement and monitor specific projects and programmes in a participatory framework.

5.1.3 They should be integrating the gender component in their work and address the issue of social equity in their programmes.

5.2 Financial Status

The organization should have a sound and sustainable financial position. The NGO/ VO should have utilized funds / implemented programmes continuously for the last 3 years and to minimum level of Rs. 10 lakh in any of last 3 years. This can be suitably reduced by Relaxation Committee keeping in view the project cost and implementation period.

5.3 Location

.5.3.1 NGOs / VOs with local experience should be preferred.

5.3.2 The NGO / VO should have a separate and functional office.

5.3.3 NGOs located outside state with adequate experience can be considered on merits.

6 CAPACITY

6.1 Manpower

6.1.1 Core (including Chief Executive, (CE))

6.1.1.1 The Voluntary Agency should have 2 regular full time staff members, besides CEO.

6.1.1.2 Its chief functionary / Secretary should be a full time worker of the organization.

6.1.1.3 Presence of adequate female staff in the organization shall be desirable.

6.1.2 Augmentation

6.1.2.1 AD may prescribe additional manpower requirement for meeting specific project needs.

6.1.2.2 NGO / VO may be required to detail out proposed augmentation in this backdrop.

6.2 Mobilization of Resources

6.2.1 Fund Mobilization

6.2.1.1 The NGO / VO should have capacity to mobilize funds from donors, beneficiaries or contribution from public.

6.2.1.2 The NGOs are expected to mobilize the funds equal to 10 per cent of the total cost of the project in the tribal areas and equal to 20 per cent of cost of project in the non-tribal areas from the community or their own sources. The community contribution to the project cost could be in cash or in labour or in kind.

6.2.2 Community Mobilization and Peoples' Participation During field assessment, the appraisal must assess community's role in decision-making in the activities done by the organization in the village.

6.3 Physical Infrastructure

The basic infrastructure of the Organization should be in place.
(Office furniture, equipments, tools and implements etc.)

7. CREDIBILITY

7.1 Performance

7.1.1 The organization should have good track record which should be supported by certificate from the concerned offices, where it has worked earlier.

7.1.2 The NGOs / VOs should not be in the list of organizations blacklisted by CAPART / CSWB / Government

or any donor agency during last three years.

7.2 Accountability

7.2.1 NGOs / VO should have a proper system of accounting and manpower management.

7.2.2 The organization must have a regular system of auditing of accounts.

7.3 Evaluation, Impact Studies and Findings

The track record of the organization can be seen from the previous projects carried out by the organization and evaluation reports of these projects.

8. CATEGORIZATION

Keeping in view all the above listed parameters, NGOs/ VO can be categorized by the AD.

8.1 Categories for Selection Interested organizations would be selected under the following two categories:

8.1.1 General: Only those organizations, which have worked in any water related sector and possess experience in creating awareness, organizing communities for participatory creation / rehabilitation of existing schemes of irrigation/domestic water supply/water harvesting and conservation / minor irrigation development and management including community lift irrigation project / watershed development and management / artificial recharging of ground water / integrated water resources development (surface and ground water) and subsequent operation, maintenance and management and have executed construction works in a participatory manner should be empaneled in this category.

8.1.2 . Professional: Organizations which possess strong professional capacity in terms of highly qualified and experienced manpower and long-standing proven track record in any of the fields related to water sector should be empaneled under this category.

9. PROCEDURE FOR REGISTRATION

9.1 Call for Expression of interest (including terms of reference) providing registration of NGOs / VO (through open advertisement)

9.1.1 The concerned department/project authorities shall invite application from the NGOs / VO for registration.

9.1.2 Any NGO / VO desirous to be registered may apply to the Chairman of the State-level Registration Committee for registration enclosing all the required information as stated in clause 4.4 above. The State Level Registration Committee shall comprise of the following:-

Principal Secretary, Water Resources (Chairman)

Secretary PHED

Secretary, Rural Development

Secretary, Finance (Expenditure)

Secretary, Water Resources; (Member Secretary)

An expert in integrated water management (to be nominated by GoR):

9.1.3 Project authorities may also organize an interface meeting with potential NGOs at the district / state level.

9.2 Short listing

9.2.1 NGO / VO who submit their application for registration shall be short listed and ranked according to the scores obtained by them as per evaluation criteria mentioned below: -

9.2.2 Marking

The Table below shows the marking scheme:

No	Criterion	Marks
1	Governance and management	25
	Governing body meetings held as per by-laws	5
	Activities in accordance with objectives, vision, mission and goals	5
	Budgets and annual plans approved by board	5
	Democratic, participatory and transparent	5
	Transparency in functioning	5

2	Reputation and rapport	15
	Community	5
	Local elected representatives	5
	Government	5
3	Organisational systems	20
	Role clarity among staff	3
	Maintenance of financial records and statements	5
	Audited accounts for last three years	4
	Publication of annual reports	4
	Perspective/strategic plans	4
4	Outreach to community	10
	Number of households (minimum 10,000)	3
	Number of villages (minimum 100)	4
	Number of community institutions established and surviving (1 mark for every 2 organisations)	Max 3
5	Full-time manpower	35
	Number of full time staff (1 mark for every 2)	Max 5
	Professionals (technical, engineers, agriculture scientists, environment specialist) (1 mark for every 2)	Max 10
	Social scientists (post graduate) (1 mark for every 2)	Max 5
	Community organisers (2 marks for every 3)	Max 5
	General graduates (1 mark for every 2)	Max 5
	Number of female staff (1 mark for each)	Max 5
6	Financial robustness last year (finance availability, 1 mark for every Rs 5 lakh)	20
7	Quality and quantity of works completed	45
	Community organisation promoted (1 mark for every 5)	10
	Construction/rehabilitation work (1 mark for every 3 works)	15
	Maintenance and post project management (1 mark for every 3 works)	15
	Project impact (2 for each project studied in last 3-4 years)	5
8	Familiarity with work area	45
	Working in the same district (5 marks for each year)	25
	Working in Rajasthan (3 marks for each year)	15
	Working elsewhere	5
9.	Experience in water sector	85
	Water harvesting and/or distribution for drinking, irrigation, , such as small dams/anicuts/pick-up weirs and canals (1 mark for each work)	35
	Village johar/pond (1 mark for each pond)	10
	Community lift irrigation schemes (1 mark for each scheme)	15
	School/community building water harvesting (1 mark for each)	5
	Water harvesting and recharging of groundwater (1 mark for each)	10
	Watershed development and management (1 mark for each)	10

Notes:

1. Higher weightage is given to manpower available, quality and quantity of work carried out, familiarity with the work area and experience in the sector;
2. Out of the total 300 marks, the NGO who score a minimum 150 marks will be eligible to take a work upto Rs. 15 lac and who score a minimum of 210 marks will be eligible for the works above Rs. 25 lac. NGOs scoring more than the minimum required may be given preference in allocation of the works. NGOs working in the water sector for more than 25 years may be given an additional 25 marks; another 25 marks may be given to NGOs which have implemented more than 150 community water resources systems;
3. While the above marking system will be generally applicable. However, special category of NGOs mentioned in 8.1.2 above may be considered for registration without adopting the process of appraisal, taking them as distinguished NGOs with proven track record. The later part of point 2 above in this note for additional marks for the exceptional experience and achievements would give an edge to exceptional NGOs;
4. The government/concerned department should strictly adhere to the marking system and other provisions provided in the guidelines so that only deserving NGOs are encouraged.
5. The selection process shall be fully transparent.

9.3 Appraisal and Exceptions

- 9.3.1 Short listing and categorization of NGOs may be attempted by evaluation of the technical capability and financial standing of NGOs.
- 9.3.2 The appraisal exercise on the basis of above marking system may be carried out promptly, preferably within 60 days of submission of the application. The State Level Registration Committee may review Appraisal Report, if considered necessary for which a team of at least three officers should visit the short-listed NGOs. The team should include at least one officer with experience of working with NGOs; others should have adequate technical and financial experience. The appraisal team should visit offices and the field of working of the NGOs and should hold discussions with the community and the staff of the organization. The appraisal team must give its assessment report with scores on each of the parameters listed above.
- 9.3.3 In deserving cases with exceptional experience, this exercise may be dispensed with substantive justifications, so that the proposal and work of the deserving NGOs is not delayed on account of such process. Some such exceptions are listed below.
 - Highly experienced and reputed NGOs with a minimum of 10-15 years of experience in the field and proven track record may not be subjected to an elaborate appraisal exercise, such as visiting the organization. They may be empanelled on the basis of information furnished and corroborated with documentary proof.
 - Similarly, verification of the standing of NGOs implementing ongoing water sector programmes satisfactorily may not be necessary.
 - Concerned authority may dispense with the initial site verifications and other requirements for NGOs with proven track records in the water sector.
- 9.3.4 The NGO / VO who secures at least 150 marks will only be taken as qualified for registration. However those NGO/VO who fail to qualify for registration will be entitled to seek registration as and when they become qualified.
- 9.3.5 Having appraised and assessed as above, the State Level Registration Committee shall register all those NGO /VO who qualify and the decision taken by the Committee in this regard shall be final.

9.4 PROJECT APPROVAL

- 9.4.1 Registered NGO /VO may submit the project proposal to the District Level Project Approval Committee comprising of following:- District Collector (Chairman) Chief Executive Officer, ZP District Level Officer of the Project related Department Accounts Officer at District level of the Project related Department.
- 9.4.2 While preparing the project proposal, NGOs should:
 - 9.4.2.1 Choose one or a group of Panchayat(s) in the district which is/are most problematic in terms of water resource availability and/or management. They may consult the concerned Executive Engineer, people's representatives and members of PRIs and other knowledgeable people of the area;
 - 9.4.2.2 Collect all relevant information, such as inventory of water resources or prepare the same, topo maps, ground water quality data, population and land statistics, details of existing water harvesting structures and information on proposed or identified projects for irrigation, water harvesting, watershed development and other water conservation related works.
 - 9.4.2.3 Identify water-related problems and prepare plans for development of water resources including rehabilitation of existing works. While preparing plan for water resources development, availability of

safe and potable water for drinking should be ensured.

9.4.3 The following type of works can be included:

- ◆ Awareness-building in the communities.
- ◆ Capacity-building of water users' associations.
- ◆ Construction/restoration of dam for irrigation or supply of drinking water upto a capacity of 10 Mcft. Dams of larger capacity could also be considered keeping in view of the capacity and track record of NGO with specific permission of Relaxation Committee.
- ◆ Construction/restoration of village tank or nadi.
- ◆ Anicut/pickup weir/check dam/sub surface barrier for irrigation and or artificial recharging of groundwater.
- ◆ Watershed development works.
- ◆ Construction of water harvesting and conservation structures.
- ◆ Any other type of water harvesting and conservation structures for community.
- ◆ Rehabilitation/Maintenance of the works executed by various water sector departments.
- ◆ Maintenance and operation of minor irrigation and drinking water projects.

9.4.4. Not to contravene State and District Water Resources Plan

9.4.5 All the proposals will be examined by District Level Project Approval Committee and thereafter submitted to the State Level Project Approval Committee with its recommendation for approval.

9.4.6 The State Level Project Approval Committee comprising of the following will consider and approve works-

Pr. Secretary, Water Resources -

Chairman

Secretary, PHED

Secretary,

Rural Development Secretary,

Agriculture Secretary of the concerned Department

Head of Department (HoD) of the concerned Department

Two experts in water sector/community organization (to be nominated by GoR)

FA/CAO of the concerned Department

Chief Engineer, Water Resources Department -

Member Secretary

9.4.7 The projects costing above Rs. 100 lac would be approved by the State Government on the recommendation of the Relaxation Committee.

9.4.8 No NGO will be allowed to take up more than one work / scheme in a district. However, additional works may be allotted after seeking due approval of the State Government on the recommendation of the Relaxation Committee.

9.4.9 Relaxation Committee

9.4.9.1 Any relaxation to the conditions regarding registration/ allocation of works etc. to any NGO/VO may be given by the State Government on the recommendation of the Relaxation Committee comprising of the following:

Addl. Chief Secretary (Infra.)

Chairman

Principal Secretary Finance/

Member

Secretary Finance

Pr. Secretary, PR& R.D./

Member

Secretary, R.D.

Pr. Secretary/Secretary of the concerned Department

Member

Pr. Secretary/Secretary, W.R.

Member-Secretary

Note: State Government would mean concerning Administrative Department.

9.5 Conflict resolution mechanism

Any dispute arising between the NGO and the project authority during the course of execution may be resolved as per the provisions of agreement (Annexure -1). However in case the dispute remains still unsolved, the matter may be

referred by the District level dispute resolution committee to the State Level Project Approval Committee upon whose recommendation the State Govt. shall take a decision which will be final and binding on both the parties.

9.6 Assignment of job and signing Agreement

After final evaluation of the project proposal the task would be assigned to the respective organizations. The agreement between the two parties would be signed in the format at Annexure 1.

10. PROJECT IMPLEMENTATION

10.1 Timely execution of projects must be ensured. For this purpose, a detailed project implementation plan needs to be spelt out considering following points:-

- 10.1.1 Undertake surveys and necessary investigations according to the type of work for preparation of detailed designs and reasonable estimates of cost. Wherever necessary, detailed analysis of rates adopted should also be enclosed. The proposal should ensure maximum possible use of local materials of construction, skills and labour;
- 10.1.2 Prepare detailed plans for mobilisation and formation of organisations and cost estimates for such mobilisation;
- 10.1.3 Prepare work-plans, schedules of physical progress of works and schedules of reimbursement/payments;
- 10.1.4 Prepare exit policy; and
- 10.1.5 Get approval of the community and submit the proposal to Executive Engineer of the concerned department in the district (in case of rural development department, CEO or the officer designated by the department). During the course of execution, subletting of any activity other than involving skill not locally available would not be permitted. Proposals that do not provide for community's responsibility for maintenance and operation on a sustainable basis and a community participation of a minimum of 10 per cent of the project cost should not be entertained.

10.2 Release of Funds Funds released would be as under:-

Installment Amount First (on award of the work) 20%Second (on using 75 percent of first installment) 30%Third (on using 75 per cent of first and second installments with 40% physical progress and at least 50% of NGOs/VOs Contribution) 40%Final (on satisfactory completion of the project) 10 %The above installments are in respect of amount payable to the NGO (80 % or 90 %of the project cost as the case may be). This is applicable to the projects, which has completion period of more than six months Funds allotted for the execution of works to the NGOs will be subject to ceiling within the plan head. It would be relevant to note the following:

- (1) The above installment amounts would be calculated on the basis of projected annual expenditure.
- (2) Where projects are of the less than 6 months duration, the first installment can be given up to 30% the second being up to 75%.
- (3) Release of an installment (except first) would be after utilisation of 75% of previous installment after verification of physical progress.
- (4) AD must ensure that the funds released are secured and used for the purpose for which it is given. For this a separate bank account for each scheme/project would be opened by the NGO/VO and the details of the bank account would be intimated by the NGO/VO to the concerned AD.

An effective monitoring system should be set up to monitor the financial and physical progress of the project based on which the subsequent installments would be released on time. For this purpose, a Nodal Officer for every project shall be appointed by the concerned Administrative Department who shall monitor the physical and financial progress of the project from time to time and submit his reports to the Project Authority who shall release the installments in the light of his reports.

10.3 Physical and Financial Progress Project is to be monitored at least on quarterly basis. A team may be set up for interacting with the NGOs. The government would also have right to inspect financial accounting records and also expect audited accounts of NGO within 6 months of next financial year after completion of project.

10.4 Completion Certificate / Utilization Certificates (UC)

- 10.4.1 The NGO / VO would submit detail of the work executed and a project completion report explaining the outputs achieved etc.
- 10.4.2 The Department would carry out a field visit to verify and check the claims and would issue a project utilisation certificate / completion certificate after proper entry of detailed measurements in measurement book which shall be duly checked.

11. PROJECT COMPLETION

- 11.1 Assets would be transferred to the State Government after one year of completion of the Project or to the Local Body / Community Organisation as per decision of the State Government.
- 11.2 In case, subsequent maintenance envisages handing over of the asset to the Local Body/ Community / Beneficiaries, concerned Administrative Department may do so.
- 11.3 Exit policies are to be prepared by the NGO / VO and should form part of Detailed Project Report (DPR) / agreement.
- 12 The estimates should be sanctioned on schedule of rates as applicable in Rural Development Department. In case any item not covered under the BSR of Rural Development Department, the BSR of the concerned department will be applicable.
- 13 All the statutory deductions such as Income Tax, Sales Tax etc. may be deducted from the payments made to the NGOs and credited to the concerned head of account. Other legal obligations shall also be met by the NGOs.
- 14 In case the NGO fails to start work or leaves it in between or does not maintain the quality of work, then the work will be withdrawn from him by the project approval committee after giving opportunity of hearing and recovery will be made under PDR Act. Such NGO will also be blacklisted.
- 15 The NGOs will be able to withdraw only after one year of completion of the work. However, before doing so they will have to ensure that the stakeholders have taken over the work for its maintenance. During this one-year period after completion, the created asset should be maintained by NGO/VO to give satisfactory performance.
- 16 The NGO shall exclusively utilize the funds released to it only for the project. No amount shall be diverted for any other purpose not related with the execution of the project.
- 17 The Government may issue appropriate direction from time to time with regard to seeking involvement of NGO/VO in execution of Projects and such direction will have overriding effect.

By Order
(N.K. Gupta)
Dy. Secretary (Project) to the Govt.
Water Resources Department

AGREEMENT NO- ANNEXURE

1 YEAR- AGREEMENT FOR EXECUTION OF WATER SECTOR PROGRAMMES BY NGOs / VOs UNDER GOVERNMENT DEPARTMENT

Articles of Agreement

- (1) This deed of agreement made in the form of agreement on between the Executive Engineer/ Chief Executive Officer on behalf of the Governor of Rajasthan (Herein after referred to as the First Party) and CEO/director of NGO / VO Village District. (Herein after called as Second Party) on the terms and conditions laid in following clauses-
- (2) Scope of Contract
This contract/agreement pertains to execution of (Name of work) . It is clarified that First Party shall be owner of such works and Second Party shall act as custodian of the same.
- (3) Cost of Contract
The total cost of the work (Herein after referred to as the "total cost.") is Rs. (Rupees.....)and is based on Rural Development Department BSR of the District.
- (4) Duties and Responsibilities
The broad terms and conditions of this agreement are as under-
 - 4.1 That, the First Party, in making it's decision to get above work executed through the Second Party, has given due consideration to the claims of the Second Party about it's non profit making non Government set up, having best technical expertise and it's high objectives of improvement of living conditions of socially and economically weaker section of the society and rural people through land and water resources development. The Second party therefore assures the First Party to maintain the claimed standards in all respects.
 - 4.2 That, the Second Party shall prepare and submit the designs, drawings and specifications for the said work and shall execute the work after obtaining approval of the same from competent authority.
 - 4.3 The First party agrees to pay the total cost of the project to the Second party in installments as under- 20% - First (on award of the work) 30% - Second (On using 75% of first installment)

40% - Third (On using 75% of first and second installments with 40% physical progress and at least 50% of second party's contribution) 10% - Final (On satisfactory completion of the project) These percentage installments are in respect of amount payable to the NGO / VO (80% or 90% of the total project cost as the case may be).

4.4 The Second Party will start the work immediately on the release of first installment and will complete the project within time. However, if there are circumstances beyond the control of the Second Party, the period may be extended by the State Level Project Approval Committee where project sanctioned by District Level Committee and by Relaxation Committee where project was sanctioned by State Level Committee with recorded justifications.

4.5 In case the Second party fails to start the work or leaves it in between or does not maintain the quality of work, then the work will be withdrawn from him and recovery will be made under PDR Act. If needed FIR may also be lodged. The Second Party will be blacklisted for future.

4.6 The Second Party shall exclusively utilize the funds released to it for the project. No amount shall be diverted for any other purpose not related with the execution of the project.

4.7 All the statutory deductions such as income tax, sales tax etc may be deducted from the payments made to the Second Party and credited to the concerned head of account. The Second Party must ensure that all the taxes are also paid at required stages.

4.8 On completion of the project, the second Party will ensure the operation and maintenance of the project by forming an organization of beneficiaries. The Second Party will provide training to the beneficiaries for the maintenance of the project.

4.9 The construction work will duly supervised and check- measured by the competent authority of the Technical Department as may be decided by the First party. The Second Party will maintain the necessary measurement books and also furnish the completion certificate, supported by the final MBs. The MBs could be verified by the Technical Department authorized by the First party. Similarly, on completion of the project, the accounts duly certified by the Chartered Accountants would be submitted by the Second Party to the First Party.

4.10 The Second Party will use material as per specifications and ensure technical soundness of the project. The Second Party will maintain full transparency in the purchase of materials etc.

4.11 If there is any saving on completion of the project, the benefit of the same will go to the Government. Similarly, in extra ordinary circumstances of variation in the market rates of major items like cement, steel etc., the adjustment/ variation would be considered as per provisions of PW&FAR formula with full justifications for the projects costing more than Rs. 50.00 lacs with completion period more than 6 months.

4.12 The First Party will ask for necessary explanations and justifications, if the progress is not satisfactory or the amount is not utilized properly by the Second party. The First Party will have the right to terminate the agreement after giving one-month notice, if satisfactory explanations are not provided by Second Party. The Second Party will refund the balance amount to the First Party with interest of 18%. Similarly, if proper cash flow is not provided by the First Party after using successive installment and there is lack of support from the government departments resulting in slow progress, the Second Party will refer the matter to the committee constituted under this agreement

4.13 All the books of accounts, registers of assets created and other material information relating to utilization of funds shall be made available by the Second Party for inspections and scrutiny to first Party as and when asked for.

4.14 The First Party reserves the right to levy interest by way of penalty on the amount sanctioned and disbursed in the event of continued default in terms and conditions of the agreement by the Second Party.

4.15 The Second Party must produce the Utilisation and Completion certificate alongwith audited accounts to the First party within 6 months after stipulated completion period.

4.16 In case of any dispute arises between the parties during the course of execution of the project the same shall be referred to the following dispute resolution committee :

District Collector (Chairman)

Chief Executive Officer, Zila Parishad Member Secretary

Representative of Technical department Representative of Second Party

4.17 The member Secretary shall place the matter before the committee and committee after hearing both the parties and looking into the relevant record amicably resoled the dispute or difference between the parties within a period of one month from the date of receipt of the matter.

This agreement has been executed on at by both the parties.

First Party :

Second Party :

Witness : 1. Name & Signature

2. Name & Signature

हार्डिक शुभकामनाओं सहित

पानी की हर बूँद की बचत के लिये संकलिपित

उच्च जलाशयों एवं यानी की टंकियों के निर्माता

गोविन्द प्रसाद गुप्ता

मानसरोवर, जयपुर

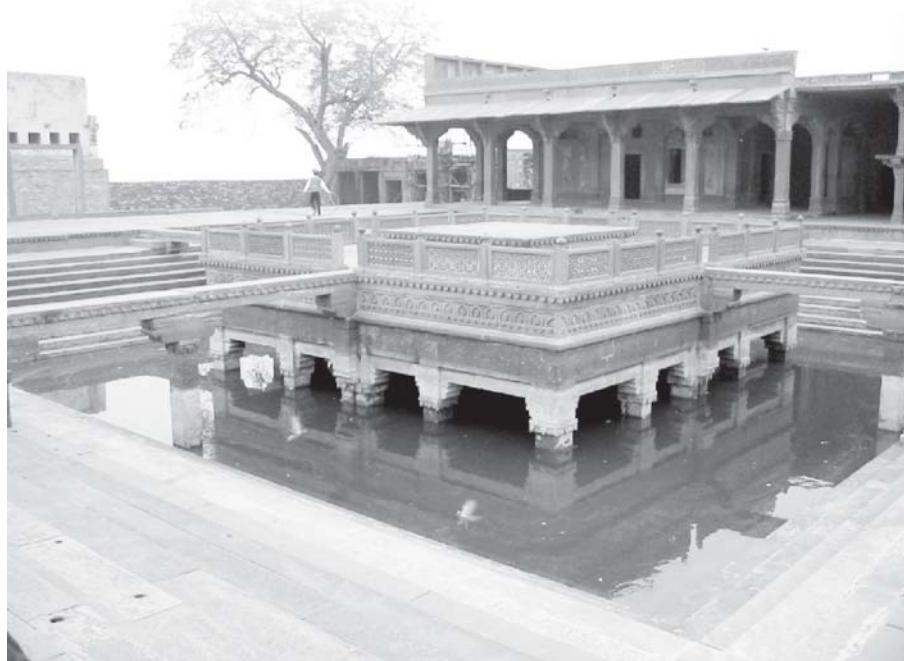
Traditional Management of Water

Our ancient religious texts and epics give a good insight into the water storage and conservation systems that prevailed in those days. Over the years rising populations, growing industrialization, and expanding agriculture have pushed up the demand for water. Efforts have been made to collect water by building dams and reservoirs and digging wells; some countries have also tried to recycle and desalinate (remove salts) water. Water conservation has become the need of the day. The idea of ground water recharging by harvesting rainwater is gaining importance in many cities.

In the forests, water seeps gently into the ground as vegetation breaks the fall. This groundwater in turn feeds wells, lakes, and rivers. Protecting forests means protecting water 'catchments'. In ancient India, people believed that forests were the 'mothers' of rivers and worshipped the sources of these water bodies.

Some ancient Indian methods

The Indus Valley Civilization, that flourished along the banks of the river Indus and other parts of western and northern India about 5,000 years ago, had one of the most sophisticated urban water supply and sewage systems in the world. The fact that the people were well acquainted with hygiene can be seen from the covered drains running beneath the streets of the ruins at both Mohenjodaro and Harappa. Another very good example is the well-planned city of Dholavira, on Khadir Bet, a low plateau in the Rann in Gujarat. One of the oldest water harvesting systems is found about 130 km from Pune along Naneghat in the



Western Ghats. A large number of tanks were cut in the rocks to provide drinking water to tradesmen who used to travel along this ancient trade route. Each fort in the area had its own water harvesting and storage system in the form of rock-cut cisterns, ponds, tanks and wells that are still in use today. A large number of forts like Raigad had tanks that supplied water. In ancient times, houses in parts of western Rajasthan were built so that each had a rooftop water harvesting system.

Rainwater from these rooftops was directed into underground tanks. This system can be seen even today in all the forts, palaces and houses of the region. Underground baked earthen pipes and tunnels to maintain the flow of water and to transport it to distant places, are still functional at Burhanpur in Madhya Pradesh, Golkunda and Bijapur in Karnataka, and Aurangabad in Maharashtra.

Rainwater harvesting

In urban areas, the construction of houses, footpaths and roads has left little exposed earth for water to soak in. In parts of the rural

areas of India, floodwater quickly flows to the rivers, which then dry up soon after the rains stop. If this water can be held back, it can seep into the ground and recharge the groundwater supply.

This has become a very popular method of conserving water especially in the urban areas. Rainwater harvesting essentially means collecting rainwater on the roofs of building and storing it underground for later use. Not only does this recharging arrest groundwater depletion, it also raises the declining water table and can help augment water supply. Rainwater harvesting and artificial recharging are becoming very important issues. It is essential to stop the decline in groundwater levels, arrest sea-water ingress, i.e. prevent sea-water from moving landward, and conserve surface water run-off during the rainy season.

Town planners and civic authority in many cities in India are introducing bylaws making rainwater harvesting compulsory in all new structures. No water or sewage connection would be given if a new

SAVE WATER

Simple techniques can be used to reduce the demand for water. The underlying principle is that only part of the rainfall or irrigation water is taken up by plants, the rest percolates into the deep groundwater, or is lost by evaporation from the surface. Therefore, by improving the efficiency of water use, and by reducing its loss due to evaporation, we can reduce water demand. There are numerous methods to reduce such losses and to improve soil moisture. Some of them are listed below. Mulching, i.e., the application of organic or inorganic material such as plant debris, compost, etc., slows down the surface run-off, improves the soil moisture, reduces evaporation losses and improves soil fertility. Soil covered by crops, slows down run-off and minimizes evaporation losses. Hence, fields should not be left bare for long periods of time. Ploughing helps to move the soil around. As a consequence it retains more water thereby reducing evaporation. Shelter belts of trees and bushes along the edge of agricultural fields slow down the wind speed and reduce evaporation and erosion. Planting of trees, grass, and bushes breaks the force of rain and helps rainwater penetrate the soil. Fog and dew contain substantial amounts of water that can be used directly by adapted plant species. Artificial surfaces such as netting-surfaced traps or polyethylene sheets can be exposed to fog and dew. The resulting water can be used for crops. Contour farming is adopted in hilly areas and in lowland areas for paddy fields. Farmers recognize the efficiency of contour-based systems for conserving soil and water. Salt-resistant varieties of crops have also been developed recently. Because these grow in saline areas, overall agricultural productivity is increased without making additional demands on freshwater sources. Thus, this is a good water conservation strategy. Transfer of water from surplus areas to deficit areas by inter-linking water systems through canals, etc. Desalination technologies such as distillation, electro-dialysis and reverse Agricultureosmosis are available. Use of efficient watering systems such as drip irrigation and sprinklers will reduce the water consumption by plants.

building did not have provisions for rainwater harvesting. Such rules should also be implemented in all the other cities to ensure a rise in the ground water level. Realizing the importance of recharging groundwater, the CGWB (Central Ground Water Board) is taking steps to encourage it through rainwater harvesting in the capital and elsewhere. A number of government buildings have been asked to go in for water harvesting in Delhi and other cities of India.

All you need for a water harvesting system is rain, and a place to collect it! Typically, rain is collected on rooftops and other surfaces, and the water is carried down to where it can be used immediately or stored. You can direct water run-off from this surface to plants, trees or lawns or even to the aquifer.

Some of the benefits of rainwater harvesting are as follows
Increases water availability
Checks the declining water table
Is environmentally friendly
Improves the quality of groundwater through the dilution of fluoride, nitrate, and salinity
Prevents soil erosion and flooding especially in urban areas.

Conservation of water in the agricultural sector is essential since water is necessary for the growth of plants and crops. A depleting water table and a rise in salinity due to overuse of chemical fertilizers and pesticides has made matters serious. Various methods of water harvesting and recharging have been and are being applied all over the world to tackle the

problem. In areas where rainfall is low and water is scarce, the local people have used simple techniques that are suited to their region and reduce the demand for water. In India's arid and semi-arid areas, the 'tank' system is traditionally the backbone of agricultural production. Tanks are constructed either by bunding or by excavating the ground and collecting rainwater.

Rajasthan, located in the Great Indian Desert, receives hardly any rainfall, but people have adapted to the harsh conditions by collecting whatever rain falls. Large bunds to create reservoirs known as khadin, dams called johads, tanks, and other methods were applied to check water flow and accumulate run-off. At the end of the monsoon season, water from these structures was used to cultivate crops. Similar systems were developed in other parts of the country. These are known by various local names ¾ jal talais in Uttar Pradesh, the haveli system in Madhya Pradesh, ahar in Bihar, and so on.

Water conservation

The most important step in the direction of finding solutions to issues of water and environmental conservation is to change people's attitudes and habits ¾ this includes each one of us. Conserve water because it is the right thing to do. We can follow some of the simple things that have been listed below and contribute to water conservation. Try to do one thing each day that will result in saving water. Don't worry if the savings are minimal ¾ every drop

counts! You can make a difference. Remember to use only the amount you actually need. Form a group of water-conscious people and encourage your friends and neighbours to be part of this group. Promote water conservation in community newsletters and on bulletin boards. Encourage your friends, neighbours and co-workers to also contribute. Encourage your family to keep looking for new ways to conserve water in and around your home. Make sure that your home is leak-free. Many homes have leaking pipes that go unnoticed. Do not leave the tap running while you are brushing your teeth or soaping your face. See that there are no leaks in the toilet tank. You can check this by adding colour to the tank. If there is a leak, colour will appear in the toilet bowl within 30 minutes. (Flush as soon as the test is done, since food colouring may stain the tank.) Avoid flushing the toilet unnecessarily. Put a brick or any other device that occupies space to cut down on the amount of water needed for each flush. When washing the car, use water from a bucket and not a hosepipe. Do not throw away water that has been used for washing vegetables, rice or dals ¾ use it to water plants or to clean the floors, etc. You can store water in a variety of ways. A simple method is to place a drum on a raised platform directly under the rainwater collection source. You can also collect water in a bucket during the rainy season. ■

Compiled by : CMRD TEAM

What is RWH ?

Rain Water Harvesting is a way to capture the rain water when it rains, store that water above ground or charge the underground and use it later. This happens naturally in open rural areas. But in congested, over-paved metropolitan cities, we need to create methods to capture the rain water.

A sample urban installation - Roof rainwater collection - in a metropolitan city

- ◆ If you live in a single dwelling house or a multi-tenant apartment complex, you already have 80% of the RWH system. We just need re-orient the plumbing



design.

- ◆ The present design of the house will take all the rainwater from the roof and all the ground level areas surrounding the house and flow the water towards the street. (where it floods the street, clogs the storm drains and sewer lines for a few days, before flowing away as sewage water)
- ◆ From the roof tops, bring the rainwater down using closed PVC pipes and direct it to a sump. Include a simple 3-part filtration unit consisting of sand, brick jelly and broken mud bricks
- ◆ If you do not have sump, use a well. In many parts of the country, old wells when they go dry, is used as garbage dumps. Please clean the well and put the rain water into it.
- ◆ If you do not have a well, construct a baby well (about 2ft in diameter and about 16 feet deep based on soil structure)
- ◆ Other types of RWH - collect the ground water and stop their flow at the gate. Put a concrete slab with holes in it, build a 2 feet deep pit, across the full width

of the gate. Collect and connect a pipe and flow the water to a well or a baby well.

Costs

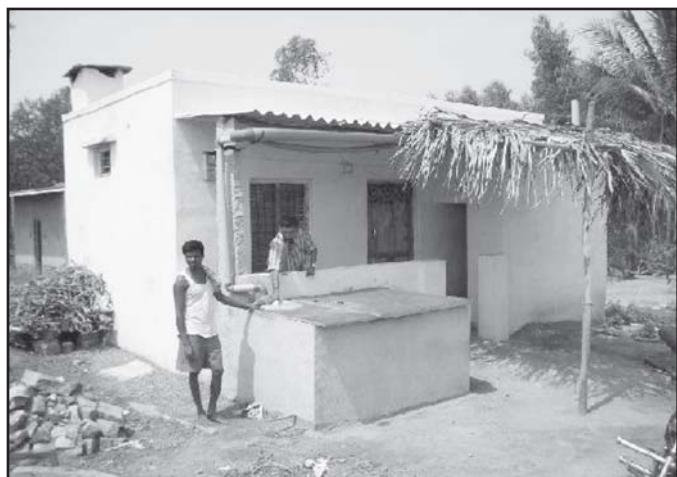
All costs are subject to local variations in different parts of India. Use these figures for budgetary purposes only.

- ◆ Most often, the cost is from the PVC pipes. A 4" diameter PVC pipe costs Rs xx per linear foot. A 5" pipe costs lot more than a 4" pipe.
- ◆ If you do not have a sump, include about Rs 5 per litre of water storage. So, a 10,000 litre size sump will cost Rs 50,000. (For a family of 4, using about 80 litres per day per person, this 10,000 litre size sump will contain 1 month's water needs for this family.)
- ◆ If you do not have old style well - 6' to 8' diameter and about 60 feet deep, it will cost about Rs 5,000.
- ◆ If you wish to construct a baby well, it may cost around Rs 2,500

Benefits

- ◆ A water tanker bringing water from unknown sources and untested for its quality will cost about Rs 1000 to Rs 2500 for 10,000 litres of water.
- ◆ You cannot put a price on 'peace of mind' knowing that you have water for a month.

Did you know that..



- ◆ A well is not for storing water. The well connects the surface to the underground water sources. Based on the underground water availability during a rainy season, the water level in the well will go up and down.

Compiled by : H. Joshi

SOME THOUGHTS & ACTION POINTS

■ **O. P. MATHUR**



O. P. MATHUR

Baring certain area of arid region where the annual rainfall received is low and erratic sufficient annual rainfall of clean water is received in Rajasthan.

One of the important limitation of the rainfall is that most of it is received during a short period of rainy season starting from mid June and terminating by mid September. In Western Rajasthan this period is further gets reduced to July and August only. Many times it is coupled with erraticity and prolonged dry spells. As per Human Development Report of United Nations, populations of human beings facing the water crisis will rise from 8 millions to 30 millions with in the next 25 year. It is now clearly visible that wars in future would be fought for water.

Drinking Water Sources

Dependence on ground water for drinking water supply is very high and about 90% requirement is met from ground water. The use of water for domestic purposes like washing floors, cleaning utensils, kitchen, washing clothes, toilets, bathing etc. is considerably high and in many cases excessive and full of wastage.

Status of Water Resources

Total available cultivable land in the state is about 257 lac hectares. Out of total potential area which can be irrigated is 51.0 lac ha while irrigation potential so far exploited is 31.7 lac ha. Among major irrigation and drinking water sources are rivers, reservoirs, wells, tanks and canals. In low rainfall

areas of arid and semi arid regions, water is stored in traditional 'Bawadies', farm ponds, Diggies etc. The fast deteriorating situation with regard to ground water availability is depicted from the table given below which is self explanatory. Excessive dependence on dwindling ground water resources now need its optimum utilization and sincere efforts to artificially recharge it urgently.

*Complete ground water exploitation x 100 Ne annual ground water availability

Note : Tara Nagar block of Churu district is completely saline.

Comand Area Development and Judicious Use Of Water.

Breif review of status of command area development for Rajasthan is summarized below:

- (i) Total cultivable agriculture land 257 lac ha.
- (ii) Out of total potential for irrigation development in 55 lac ha, an area of 31.66 lac ha has so far been covered.
- (iii) Out of total 4969 irrigation project, big and medium are 109 small irrigation project are 486.
- (iv) There is complete lack of sense of belonging, responsibility and awarness among the masses towards importance of water. Though efforts have been initiated in this direction by forming Water U s e r s Association (WUA) and gradually giving them desired responsibilities in Canal Command Areas.
- (v) Prevalance of traditional wasteful method of irrigation method of irrigation through making causes misuse and wastage of water.

MODEL OF RWH IN JAIPUR



Construction of roof top rain water harvesting structure was done to recharge ground water all the residence of Mr. O.P. Mathur, Sector-1, House No. 1301 Malviya Nagar, Jaipur 302017 during the year 2005. As per guidance provided by Groundwater Department, Jaipur, Filter pit of 1.0 (length) x 1.0m x 1.5 (depth), collection tank (1.0m x 1.5m x 1.5m) and 100mm diameter borehole upto a depth of 50m where ground water level arrived were constructed. Cement rings upto a depth fo 10m were installed so that sand from the sides does not choke the passage of water entry. Round gravels were filled into fileter pit around recharging holes. Rainwater from roof top was brought dorwn through HD pipes of 15cm diameter and carried upto filter pit. G.I. Pipe was also fitted as Air Vent. The entire installation costed about Rs. 11000/- . The cost can be substantially reduced by Rs. 3000/- to 5000/- if a common bore is dug between two or more houses. It is recommended that all houses whether big or small and new or old must have the structure. Government may consider provision of some subsidy as an incentive for its quick and wide adaptation. Thus all the roof tops will become water collection structures with no percolation losses and help in boosting up much needed ground water recharging.

*(Author is Retd. Jt. Director Agriculture Govt. of Raj.)

पानी के भोर्चे पर महिलाएं

■ डा. विनीता गुप्ता



डा. विनीता गुप्ता

द१ ई साल की मासूम शांति हर रोज अपनी दादी के साथ घर के बाहर चबूतरे पर बैठ जाती और टुकुर-टुकुर देखती रहती, बड़ा सांघृंघट निकाले सिर पर घड़ों में भर पानी भरकर लाती हुई औरतों



की। 15-20 औरतें उसकी आँखों के आगे से चली जाती, लेकिन जब उनमें कोई भी उसकी माँ नहीं होती तो वह फूट-फूट कर रो पड़ती। दरअसल कुछ दिन पहले ही उसकी माँ अपनी प्यारी बिटिया शांति को अकेला छोड़कर ईश्वर का प्यारी हो गई थी। वह जब भी पूछती दादी से माँ कहाँ गई है? तो वह बताती है ' पानी भरने गई है, दूर बहुत दूर वाले कुएँ से?...., राजस्थान के भरतपुर जिले की नदबई तहसील के लालपुर गाँव की वह नहीं शांति अब शारदा के रूप में 73 साल की हो गई, लेकिन शायद न मिटी उनकी पानी की ललक और न ही खत्म हुई सिर पर घड़े रखे माँ के लौटने का इंतजार तभी तो महानगर दिल्ली में रहते हुए घर में 24 घंटे भरपूर पानी होते हुए भी

वह घर के छोटे-बड़े बर्तनों में पानी भर कर रखती हैं। दरअसल वह व्याह कर आगरा के पास एक गाँव में गई तो वहाँ भी पाली लाने की जिम्मेदारी उसी पर थी। रोज सुबह शाम दो किलोमीटर दूर से पानी भर कर लाती माथे पर बोड़ला, पाँव में भारी कड़े, चेहरे पर लम्बां घूंघट, एक हाथ में भारी रस्सी, सिर पर कलसे गागर। आधी जिन्दगी, घर भर के लिए पानी का इंतजाम करने मेंही बीती और अब पानी भरना उनकी आदत में शुमार हो गया है। क्यों

महिला श्रम दिवस का निवेश पीन लाने में होता है। अगर इसे भारतीय न्यूनतम मजदूरी अधिनियम के तहत मुआवजे में बदला जाए तो यह राशि 10 अरब रुपये से अधिक होती है।

देश में 35 लाख हैंडपम्प, 1 लाख 16 हजार पाइप जल वितरण सुविधा के लिए हैं तथा असंख्य परम्परागत जलस्त्रोत होने के बावजूद महिलाएं एक-एक लोटा पानी के लिए भटकती नजर आती हैं। धरती में जल का स्तर निरंतर घटता जा रहा है, इस कारण उन्हें गहरे होते जा रहे कुओं से लम्बी रस्सियों से पानी खींचना पड़ता है और फिर वे इस पानी को सिर पर और कमर पर ढोकर मीलों चलती हैं। राजस्थान में लगभग हर घर में महिलाएं ही पानी लाने, खींचने, और पानी से जुड़े बाकी कामों का जिम्मा उठाती हैं। पानी लाने के लिए किया गया परिश्रम उनके स्वास्थ्य से खिलवाड़ करता है। पानी का शाप वे ही झेलती हैं।

एक अध्ययन के अनुसार भारत के ग्रामीण क्षेत्रों में महिलाएं प्रतिवर्ष 14 हजार किलोमीटर भटकती हैं। विकासशील देशों में प्रतिवर्ष 40 अरब घंटे का स्त्री श्रम पानी की तलाश में बर्बाद हो जाता है। वे अपने, सिर, कंधे अथवा कमर पर 40 लीटर तक पानी ढोकर दिन के 8-10 घंटे तक कड़ी धूप में नगे पैर चलती हैं। प्रतिदिन 9-10 किलोमीटर की यात्रा तमाम बीमारियों को न्यौता देती है।

हरियाणा के हिसार में पारिवारिक संसाधन प्रबंध विभाग द्वारा किये गये सर्वेक्षण के आंकड़े बताते हैं कि हरियाणा की 80 प्रतिशत महिलाओं की दिनचर्या का अपरिहार्य अंग है पानी लाना। ये महिलाएं कम से कम 10 मीटर लेकर 6.25 किलोमीटर तक की दूरी रोज पानी के लिए तय करती हैं। पानी भरने के लिए जाते समय उनके खाली बर्तनों का वजन 5.9 कि.ग्रा. होता है और लौटते समय यह वजन ौसतन 24.4 किलोग्राम होता है। गर्भियों में एक महिला

ौसतन 23 बर्तन प्रतिदिन भरती हैं। इनमें खाना पकाने, पीने की आवश्यकता से लेकर पशुओं को पिलाने तक का पानी होता है। पानी का एक बर्तन लाने में ौसतन 6 मिनट का समय लगता है। यानी घर का पूरा पानी भरने में

प्यासी हैं पानी के लिए उसकी आँखे ? हमारी सनातन परम्पराओं में नीर और नारी का गहरा रिश्ता बताया गया है। गाँव-गाँव में यह रिश्ता निभाती महिलाओं को पानी की चिंता में दिन गुजारते देखा जा सकता है। वर्ष 2005 में राष्ट्रीय महिला आयोग ने Water and Women शीर्षक से एक रिपोर्ट प्रकाशित की थी। 242 पृष्ठों की इस रिपोर्ट में बताया गया है कि पानी हमारे देश की महिलाओं के चिन्तन का प्रमुख विषय तो है ही यह श्रम के रूप में भी महिलाओं के कार्य का एक बहुत बड़ा हिस्सा भी नष्ट कर डालता है। एक बाल्टी पानी के लिए मीलों चलना पड़ता है और यह चलना दिन में कई बार हो सकता है। आँकड़ों के मुताबिक प्रतिवर्ष डेढ़ करोड़



138 मिनट खर्च करती हैं। इस प्रकार गुजरात के बनासकंठा जिले की महिलाएं वर्ष के 2190 घंटे अपने सिर पर पानी की गागर लाते हुए बिताती हैं। यह चौदह किलोमीटर का भटकाव दो बूँद पानी की तलाश में पूरे साल लगातार जारी रहता है। सूखे और अकाल की मार झेल रहे अधिकांश क्षेत्रों में पानी के लिए यह कठोरतम श्रम 75 प्रतिशत महिलाओं की नियति है। इन्हीं कठिनाइयों को देखते हुए ग्रामीण महिलाओं ने जल क्रांति की और उन्हें अभूतपूर्व सफलता भी मिले। जल क्रांति की अगुआ धूँधट वाली महिलाओं ने परम्परागत समाज की चारदीवारी लांघ कर ऐसी चुनौतियों से जूझकर दिखाया और बंजर धरती में जलधारा बहायी, जिसकी कल्पना करना भी सभव नहीं था।

राजस्थान के करौली जिले के खीचली गाँव की छोटी के गाँव में तालाब खोदने का काम पुरुष ही करते थे। महिलाओं ने सोचा कि हम क्यों नहीं कर सकते? और उन्होंने जब गाँव के पंचों से अपने मन की इच्छा व्यक्त की तो गाँव के पंचों ने बड़े अभद्र तरीके से कहा तुम नहीं बना सकती। महिलाओं को यह बात तीर की तरह चुभ गई। उन्होंने एक नहीं कई तलाइयों बनाने का फैसला किया। और लहंगा, चुनरी, पेटीकोट वाली इन महिलाओं ने जब चार तलाइयाँ बना लीं तो पंचों के मुँह बंद हो गए।

गुजरात के सूकावनताड़ा गाँव की धूली बेन ने अपनी ही तरह का इतिहास रचा। एक बातचीत में वह बताती है कि हमारे इलाके में पानी ही सबसे बड़ी समस्या है। पानी है तो रोजी रोटी चलती है, नहीं तो सब कुछ ठप्प। धूली बेन ने देखा कि गाँव में हैंडपम्प तो हैं;

लेकिन खराब पड़े हैं। उनमें वाटर रिचार्जिंग की जरूरत है। धूली बेन ने हिम्मत दिखाई और हैंडपम्प ठीक करने का काम सीखा। फिर अपने गाँव की 7 और महिलाओं के साथ मिलकर ऐसे हैंडपम्पों को ठीक किया जो दस वर्षों से खराब पड़े थे। जिन्हें पुरुष मैकेनिक भी हाथ नहीं लगाते थे। धूली बेन और उनकी साथिनों ने एक महीने में ही 200 से ज्यादा हैंड पम्पों की ऑयलिंग कर डाली।

यह काम आसान नहीं था। साड़ी पहनने वाली महिलाओं के लिए जमीन में गहरे धूँध से हुए पम्पों को ऊपर खींचना फिर बोरिंग करना। खतरा ही खतरा था। किन्तु धूली बेन तो खतरों से जूझने के लिए ही निकली थीं। गाँव-गाँव जाकर महिलाओं को जल आंदोलन से जोड़ा। स्त्री शक्ति का साक्षात् उदाहरण धूली बेन के काम को वर्ल्ड रुरल समिट फाउंडेशन ने अंतरराष्ट्रीय स्तर पर पहचाना और उन्हें अंतरराष्ट्रीय सम्मान से अलंकृत किया।

सच तो यह है कि भारत में पानी का सुनियोजित आंदोलन महिलाओं ने ही खड़ा किया है। चाहे वह मेघा पाटकर हों, तरुण भारत संघ के साथ काम करने वाली महिलाएं हों, दक्षिण भारत में पानी की लड़ाई लड़ रही मुताम्मा हो, उड़ीसा की बुदना हो या राजस्थान की काजोरी माई। महिलाओं ने इस आंदोलन की बागड़ोर अपने हाथ थाम ली है ये महिलाएं उनसे भी लड़ रही हैं जो पानी का तेजी से दोहन कर रहे हैं। कोका कोला की फैकट्री को लेकर केरल में खासा विवाद रहा है। इसी प्रकार मिलाई में औद्योगिक क्षेत्र में लोगों के लिए पानी नहीं लेकिन उद्योगों के लिए करोड़ों लीटर पानी है। ऐसी लड़ाई लड़ने में महिलाएं सबसे

आगे हैं। 2003 में पत्थर खोदने वाली खदान के एक ठेकेदार के खिलाफ महिलाओं ने जोरदार आंदोलन छेड़ा और जेल भी गई। कारण उस खदान के कारण जल स्तर नीचे जा रहा था। तिलंती बाई के नेतृत्व में महिलाओं ने इस आंदोलन में महत्वपूर्ण भूमिका निभाई।

राजस्थान के अलवर जिले के राजौर गाँव की 55 वर्षीय कजोड़ी ने देखा कि गाँव की महिलाओं को दूर से पानी लाने में कितनी मशक्कत करनी पड़ती है। उनकी परेशानी देखते हुए कजोड़ी ने पंचायत समिति पर दबाव बनाया और गाँव में हैंडपम्प लगाने की माँग की। किन्तु सरपंच किसी दूसरी जगह हैंडपम्प लगाना चाहता था। कजोड़ी ने इस अन्याय का जमकर विरोध किया और सरपंच को घेर लिया। यह घेराव तभी खत्म हुआ जब गाँव में हैंडपम्प लगाना शुरू हो गया। पुरुषों द्वारा लगाये जा रहे लांछनों से वह घबराई नहीं, बल्कि आसपास के 12 गाँवों में घूम-घूम कर महिलाओं को संगठित किया और जल, जंगल, जमीन के संरक्षण के लिए उन्हें प्रेरित किया।

सरिस्का की दक्षिण-पश्चिम सीमा पर वसे गाँव चंदेल नागल की निवासी 60 वर्षीय कमली गुर्जर ने अपने गाँव की समृद्धि और तबाही दोनों ही देखी। 70 के दशक से लेकर 80 के दशक तक अपने गाँव के पानी से भरे कुओं को सूखते और कर्ज में डूबे लोगों को गाँवों से पलायन करते हुए देखा। कमली को मालूम था कि गाँव की खुशहाली पानी के रास्ते ही वापस लौटेगी। वह तरुण भारत संघ से जुड़ी और उनकी अगुआई में 3 गाँवों में 40 एनिकट, जोहड़ और तालाबों का निर्माण हुआ। इन्हें बनाने में सबसे ज्यादा श्रम महिलाओं ने किया।

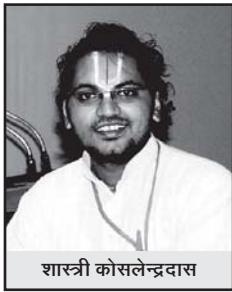
सेल्फ एम्प्लायड वूमेन ऐसोसिएशन (सेवा) के साथ मिलकर भी महिलाओं ने जल क्रांति में अपूर्व योगदान दिया। सेवा की एक टेक्नीकल टीम जल संरक्षण की दिशा में काम कर रही है, जिसमें 108 महिलाएं जुड़ी हैं। इसमें न केवल जल प्रबंधक के रूप में महिलाएं शामिल हैं अपितु प्लमबर भी महिलाएं ही हैं।

अपने अस्त्र-शास्त्र और मेघा के साथ महिलाओं ने जल मोर्चा संभाल लिया है, और इसके सकारात्मक परिणाम भी दिखाई देने लगा है। ■

* लेखिका जानी मानी स्तम्भकार हैं

संस्कृत साहित्य में जल

■ शास्त्री कोसलेन्द्रदास



हमारा भारत ही एकमात्र ऐसा राष्ट्र है, जहाँ सबमें ईश्वर को और ईश्वर में सबको देखा जाता है। नदी, पर्वत, वन, झरने, जीव-जन्तु अ। दि द स ब

सजीव-निर्जीव ईश्वर के रूप ही तो है। भारतीय संस्कृति पूरी तरह से वेद-पुराण-इतिहास-स्मृतियों पर आधारित मानी जाती है। कम ही लोग इस बात की जानकारी रखते हैं कि डॉ. भीमराव अम्बेडकर ने खुद वेद-पुराणों का अध्ययन किया था। उन्होंने एक निष्कर्ष निकाला कि इस दुनिया में ऐसा कोई ज्ञान या ऐसा कोई तत्त्व नहीं है, जो वेदों में उल्लिखित न हो। भारतीय संस्कृति के मूल में यदि हम जाने की कोशिश करें तो कई बातें एक सुखद आश्चर्य के साथ इकट्ठी प्रकट हो जाती हैं। पंच महाभूत भारतीय चिन्तन परम्परा में महत्वपूर्ण तत्त्व है। ये ईश्वर से उत्पन्न पंच महाभूत ही समस्त संसार के उपादान कारण हैं, यह बात अत्यन्त प्रगाढ़ता के साथ वेदान्त दर्शन में कई बार कही गयी है। अपनी सरल भाषा में गोस्वामी श्रीतुलसीदास इन्हें शरीर के निर्माण की सामग्री बताते हैं-

क्षिति जल पावक गगन समीरा ।
पंच रचित यह अधम सरीरा ॥

पंच महाभूतों में पृथ्वी, जल, अग्नि, आकाश और वायु हैं। सीधी-सी बात है, इन पाँचों की साध्यावस्था का नाम संसार और विषमावस्था का नाम ही प्रलय है। इन पाँचों में एक का भी कुपित होना भयंकर अरिष्टकारी है। जल तत्त्व इतना व्यापक है कि उसके बारे किसी भी जीवधारी के जीवन की कल्पना ही नहीं की जा सकती। सम्पूर्ण संस्कृत वाङ्मय में जल तत्त्व पर इतना चिन्तन किया जा चुका है, जिसकी उपरिथित होने पर विज्ञान की H_2O वाली परम्परा हजारों - लाखों वर्ष पहले ऋषि की मनीषा के द्वारा सिद्ध की हुई प्रतीत होती है।

संस्कृत साहित्य में शब्दकोष लिखने की परम्परा कई शताब्दियों पुरानी है। संस्कृत में अत्यन्त प्रसिद्ध व प्रामाणिक अमरसिं-

विचरित 'अमरकोष' में जल के 27 नाम वर्णित हैं-

आपः स्त्री भृतिन वार्वारि सलिलं कमलं जलम्। पयः कीलालमभूतं जीवनं भुवनं वनम्॥ कबन्धमुदकं पाथः पुष्करं सर्वतोमुखम्। अम्भोऽर्णस्तोयपानीयनीरक्षीदाम्बुशंवरम्॥ मेघपुष्पं घनरसः। (अमरकोष-ध-वारिवर्ग)

अप्, वा, वारि, सलिल, कमल, जल, पयस्, कीलाल, अमृत, जीवन, भुवन, वन, कबन्ध, उदक, पाथ, पुष्कर, सर्वतोमुख, अम्भ, अर्ण, तोय, पानीय, नीर, क्षीर, अम्बु, मेघपुष्प व घनरस ये सभी नाम उस जल के ही हैं, जिसे अंग्रेजी में एकमात्र शब्द Water से जाना जाता है।

वेदों में सृष्टि की उत्पत्ति की प्रक्रिया का जो वर्णन है, वहाँ अलग - अलग तरीकों से दो बातें कही गयी हैं - अप् एव ससज्जादौ अर्थात् उस ईश्वर ने सबसे पहले जल को बनाया तत्पश्चात् अन्य तत्त्वों को। दूसरी ओर - आकाशाद्वायुः वायोराग्निः अग्नेरापः आपः पृथिवी। अर्थात् अवकाश पड़े आकाश से पहले -पहल वायु प्रकट हुई। वायु से अग्नि की उत्पत्ति हुई। अग्नि में से जल प्रकट हुआ और जल पर पृथिवी। पृथिवी का जल पर आश्रित होना आधुनिक वैज्ञानिकों के मत में भी स्वीकृत है। एक अत्यन्त प्रमाणिक कथा, जो पद्मपुराण व श्रीमद्भागवतमहापुराण दोनों में ही बड़े विस्तार से पाई जाती है। जिसमें यह कथा कही गयी है कि जब देवताओं का शत्रु हिरण्याक्ष पृथ्वी को छुपाने के लिये उसे पाताल में ले गया तो भगवान् श्रीहरि विष्णु ने हिरण्याक्ष को मारकर पृथ्वी को जल पर पुनः सुरित कर दिया। अतः जल से पृथिवी उत्पन्न हुई होगी, ये तथ्य बड़े प्राचीन है। वैदिक सनातन धर्म के प्रमुख देव - नारायण का नामार्थ ही यही है। हरिवंशपुराण कहता है - 'आपो नारा इति प्रोक्ता' अर्थात् जल को 'नारा' कहा जाता है और नारा में है अयन-घर जिसका, वह है नारायण। इस तरह से संस्कृति के मुख्यदेव विष्णु ही जल पर आश्रित हैं। जल में विना क्षीरसागर की तो कल्पना भी नहीं की जा सकती है।

कविकुलतिलक महाकवि कालिदास ने तो जल के उत्पादक मेघ को दूत बनाकर एक

खण्डकाव्य की रचना ही कर दी थी, जो 'मेघदूत' के नाम से आज तक साहित्य के गगन में सूर्य के समान उपस्थित है। कालिदास बादल को धूम, अग्नि, जल और वायु का समूह कहते हैं। साथ ही मेघ को निर्जीव भी बताते हैं:-

धमज्योतिस्सलिलमरुतां सिन्धपातः व्व भेदः
सन्देशार्थाः क्वपटुकरणैः प्रापणीयाः।
इत्यौत्सुक्यादपरिगणन् गृह्यकस्तं यायाचे
कामात्मा हि प्रकृतिकृपणाश्चेतनाऽद्येतनेषु॥

जल ही सिमटकर तालाब और सागर हो जाता है। श्रीरामचरितमानस तो सागर को सज्जन और उसमें जल भरने को गुणों का संग्रहण कहती है-

सिमटि सिमटि जल भरहिं तलावा ।
जिमि सदगुण सज्जन पहिं आवा ॥

जल प्रदूषण को रोकने के व्यापक प्रयासों का भी इतिहास में भरपूर वर्णन है। भगवान् श्रीराम राजा होने के बाद सरयू पर ऐसी व्यवस्था करते हैं जहाँ स्त्री-पुरुषों के स्नान के लिए भिन्न-भिन्न रथानों पर घाटों की व्यवस्था हैं। जहाँ स्त्रियाँ स्नान करती हैं-

'तहाँ पुरुष नहीं करहि सनाना ।

'नैव मज्जनित जन्तवः' वाल्मीकि के अनुसार जहाँ मानव स्नान करते हैं या जिन तालाबों का पानी पीते हैं, वहाँ जन्तु नहीं जाते।

श्रीकृष्ण द्वारा कालियनाग को नदी से निकालकर समुद्र के किनारे भेज देना भी तो जल का संशोधन ही है अन्यथा कालिय तो यमुना में नीचे पड़ा रहता था तथापि श्रीकृष्ण जल को दूषित नहीं होने देना चाहते थे। अतः श्रीकृष्ण द्वारा यमुनाशोधन केवल लीला-मात्र ही नहीं है, अपितु वह एक सन्देश है, जो जल की स्वच्छता का अभियान चलाता है।

अंत के मध्यकालीन भक्तिकाल में हुए भक्त-कवि रहीमदास के एक दोहे को प्रस्तुत करता हूँ-

रहिमन पानी राखिये, बिन पानी सब सून ।

पानी गये न ऊबरे, मोती मानुष चून ॥

(लेखक श्री लाल बहादुर शास्त्री राष्ट्रीय संस्कृत विद्यापीठ, नई दिल्ली में शोध अध्येता हैं।)

EFFICACY OF COMMUNITY PARTICIPATION

■ **D.D. OZHA** With
K.D. DHADHICH



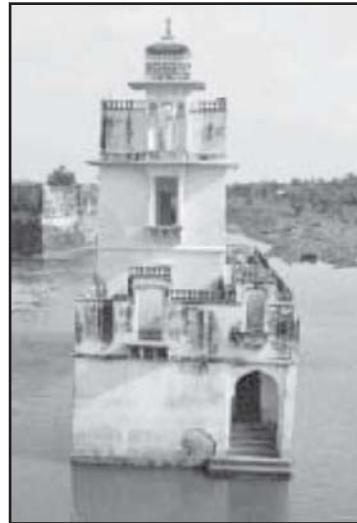
D.D. OZHA

With the increase in population and revolutionary development in the field of agriculture and industrial sectors, requirement of water has

drastically increased in our country. Consequence of rising demand of water has rapidly decreased its quantity and deteriorated the quality, thereby requires its judicious use and reuse. It has been seriously observed that most of the filtered water in our country is being wasted in our routine life owing to lack of water education and non-conservation of rain water. Voluntary organizations can play a significant role in the coming years for the management of this scarce and vital resource. Since they work at grass root level and established their credibility with the people of the area, thus with the help of experts, they can educate the common man and farmers about the water availability and judicious management and also acts as catalyst between the users and the Government for implementing policies for sustainable development.

INTRODUCTION

Water is a key to life because every living cell is a water dependent and water sustained. During pre-independence period, there was no shortage of water resources and people use to manage the resources considering this as part of the nature which is essential for their survival. This could be seen in people living in desert which have evinced an admirable sense to harness water whatever quantity they receive by the dint of rains of whatever they are able to



It is now demand of an hour that if we do not conserve the vital source then we endanger the very natural life cycle on the planet. The gravity of the problem of scarcity of water in general and drinking water in particular is borne out largely from the over exploitation of ground water.

1. Scientist & Vice Chairman, IWWA, Jodhpur Centre
2. Chief Engineer, Ground Water Department, Jodhpur. draw from under ground sources. With the advent of modern technology like hybrid seeds, chemical fertilizers, western sanitary system and modern luxurious living habits of people, the water demand took a quantum jump. Much of the domestic water requirement is consumed for sanitary purpose than cooking and washing. Tank irrigation which is in vogue is becoming lesser and lesser with the bigger irrigation projects coming up. There is also change in the cropping pattern which requires more water.

It is now demand of an hour that if we do not conserve the vital source then we endanger the very natural life cycle on the planet. The gravity of the problem of scarcity of water in general and drinking water in particular is borne out largely from the over exploitation of ground water.

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Recently there is a shift in the Government policy wherein it emphasizes on participatory principles, bottomup approaches, decentralized planning and decision making in the context of natural resources management. In this new approach, great emphasis is being laid on reinforcing local efforts enhancing local managerial and organizational capabilities and building upon indigenous skills, knowledge and inventiveness. Peoples participation holds the key to the success of planning, development and management. Here participation means creating awareness and complete involvement in planning and execution. Voluntary organizations play a role in educating the people for managing this scarce and vital resource.

1. **Water Resource :**
Our country is blessed with an

average annual rainfall of 1170 mm. Varying from 100 mm in the Western Rajasthan to more than 11,000 mm in Meghalaya. One third of the country is drought prone and one eighth of the country is flood prone. The total amount of rainfall estimated to be of the order of 400 mm. The available surface water resource is estimated to be 180 mm out of which only 80 mm could be harnessed to create an irrigation potential of 76 mm. It is obvious that since water resources are not distributed over the country owing to varying hydrogeological and hydrological conditions, there is an over exploitation of this resource in many parts of the country leading to disastrous situations viz. drying of wells, deterioration of ground water quality, sea water intrusions into coastal aquifers, salinisation of soils affecting productivity of agricultural production and high energy consumption to lift water from greater depths.

2. Necessity of community participation:

Due to accelerated growth in population and the very high rate of migration of rural population to urban centers, the water supply systems of all the cities and town requires to be continuously augmented. This naturally leads to tapping distant additional sources and transporting, processing and distributing water from these to mitigate the demands of increasing population which in turn involves large capital investment. It has been now realized¹ that the objective of supplying safe water cannot be achieved unless community is mobilized to manage the water system. Government programmes for water cannot fructify unless the community is mobilized to, own and sustain these programme and to become an active partner in their promotion. This calls for intensified efforts for bringing about attitudinal changes in the people, leading to change in their habits and practices. Thus the need of people's participation was realized.

leading to change in their habits and practices. Thus the need of people's participation was realized.

Community participation

represents awareness of the people to do something, the way, they want, or to influence the activity. This is not a new concept as such. Till the period just after independence, certain works were being carried out jointly. Activities like digging a public well, constructing building for the school/local body, emptying the well for cleaning, fire fighting or even night watch to protect against robbery etc. were successful, only because of joint efforts and participation and sense of fraternity was the driving force.

Earlier voluntary organizations which are charitable trusts or welfare oriented organizations in the country were giving priority to health, education, women and child welfare and animal husbandry. It is only during the last two decades, the country is facing the water shortage and most of the voluntary organizations have included water management in their activities. For Planning and execution of water management project there is need of interest among the people. Ground water management could be effective if we follow various Information, Education, communication activities. These will automatically involve the community to actively participate in the ongoing programme.

Mandatory steps of water management Following are the possible mandatory steps for water management.

(a) Constitution of Pani Panachayat
Pani Panchayat or Watson Committee, constituted by village panchayat / Gram Sabha, comprises members of the gram sabha or leaders of the village/hamlets. The village panchayat must take initiative to organise campaigns to create awareness about the importance of safe water supply. Periodic meeting of the committee be organized by PRI's, which can prepare plan of action for safe drinking water supply.
prepare plan of action for safe drinking water supply.

(b) Water Use Policy Today, need of hour is a proper land and water use policy, which has been a target subject of National Water

Policy of year 1998. As a result of over exploitation of ground water through various means and allied causative factors there is a great damage to the aquifers and its related systems. Therefore, what one need is a strict audit of water for its various uses, viz. industrial, agriculture and domestic. The water use policy should take into consideration climatic and cultural conditions of the state and should influence decision making pattern of various state Govt. departments. Some of these aspects are as follows.

1. Discourage cultivation of high water consuming crops in semi arid and arid areas, even if those areas are under command system. As these crops disturb not only the ecosystem of the arid region but also damage equilibrium of the soil strata and the aquifers in the regions.
2. Micro-environment of the region is affected due to dampness caused by presence of excessive water this led to poor germination percentage.
3. Industries should not be allowed to use water more than its optimal needs. Excessive use leads to discharge of more polluted water than necessary.

Water Education for Waste Water Control

It has been observed that to a large scale the problem of water scarcity is an outcome of water being supplied to human population through regularly operated supply system. With this network having got enlarged and further getting enlarged the use of water has gone up manifold. We valued water in the past as it used to be fetched and carried from long distances. But now it is available in the dwelling units of families and people tend to use it more and more. In our country the loss of treated water through leaks in water distribution systems may, at a conservation estimate, amount to 10 billion cum per

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Water waste may be caused due to leakages from service reservoirs and treatment units of water works, water mains due to corrosion, fracture, faulty joints, ferole connection etc. and service pipe fitting inside the consumer's premises due to joints corrosion, faulty washers in glands in valves and taps. Another important source of waste is in intermittent systems, particularly where metering is not enforced, is the tendency of the house holder to keep the taps open throughout also discarding stored water to be replaced by fresh water. Therefore, it has been experienced that if water education be given to school going children through lectures, posters, essay competitions or mentioning chapters on water in their usual course book. Then certainly it will have impact on the rational use of water. Author (DDO) has practically performed this experiment in 10-20 schools of Jodhpur by delivering lectures using audio-visual aids and obtained encouraging results for the conservation of this vital resource.

It Table 1 suggestive measures are given to avoid wastage of water in routine life.

Table 1 Suggestive measures of Waste water Control in routine life. A perusal of Table-1 reveals that by cultivating aforesaid water conservation habits, we can save large quantity of wastage of water.

Water management in Desert area

The desert parts of Rajasthan are less blessed with monsoon, thus water harvesting is deeply rooted in its social fabric. In desert area the names

Activity		Routine method	Quantity used in its	Suggestive Mehtod	Quantity req. in Ltr	Quantity wasted in Lts.
1.	Brusing Teeth	Running tap for 5 mts.	45	Tumbler or Lotha	1	44
2.	Washing hands	Running tap for 2 mts	15	Half open tap	2	12
3.	Shaving	Running tap for 2 mts	15	Shaving mug	0.5	14.50
4.	Shower	Letting shower run while soaping staying under shower for too longer period	90	Using buckets	20	70
5.	Flushing toilet	Using old fashion	15 or more	Dual system short	5	10
6.	Watering plants	Running hose for 5mts	120	Water cane	5	115
7.	Washing floor	Running hose for 5 mts	120	Mug & Bucket	18	102
8.	Washing Car	Running hose for 10 mts	240	Twoor three buckets	45	195

of water body are Nadi, Jhalra, Talab, Johad, Bandh, Sagar, Samand, Sarovar and Sar. These water places are also associated with mythology and religion. Water is such a scarce commodity in the state that nay natural source of water is naturally worshipped and most of the water resources have become pilgrimage centers in the state.

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In the desertic zone many NGO's are doing instrumental work in

conserving water by constructing small structures like check., dams, anicuts, gully plugs on existing nallahs, drains and have been tapping surface runoff. These structures have been successful in the community as they provide water for immediate use like drinking and irrigation etc. and also recharging ground water simultaneously. and irrigation etc. and also recharging ground water simultaneously.

CONCLUSION

Water resources of the country are dwindling due to mismanagement. community participation's having expertise and due creditability in the area can play a significant role in the coming years in managing this scarce and vital resource, by educating common consumers and farmers and acting as catalyst between the users and Goverment agencies in implementing the policies and projects for sustainable development.

(Author's are Scientists in CGWB, Jodhpur)

पंचमहाभूतों की वक्षा द्वाटे

दो दिविन तक चले तकनीकी सत्रों में आये सुझावों और शंकाओं के समाधान के लिए एक खुला सत्र का आयोजन किया गया था। इस सत्र का संचालक यूनिवर्सिटी ऑफ कोटा के कूलपति श्री मनोहर कालरा ने किया था। इस सत्र में विद्यार्थीक व पूर्व संत्री श्री जोगेश्वर गण, दीनदयाल शोध संस्थान विद्युत कर (म.प्र.) के सचिव डॉ. भरत पाठक सुप्रियोदय चिन्हक श्री के. एन. गोविन्द चार्य, विकास अध्ययन संस्थान के प्रो. एम. एस. राठोड़ शोध अकादमी शास्त्रीयों से सलेन्ड्र दास व दस्तावेजों व न्यायालय में शोजस्थान सरकार के अतिरिक्त महाप्रबन्ध श्री अरुण शर्म शुभा ने भाग लिया।

प्रो० मनोहर कालरा- दो दिवसीय कार्यशाला के अंतिम दौर की इस सामूहिक चर्चा में आप सभी का स्वागत है। मैं सबसे पहले राष्ट्रवादी चिंतक श्री के० एन० गोविन्दाचार्य को आमंत्रित करता हूं कि वे इस सामूहिक चर्चा की शुरुआत करें।

श्री के० एन० गोविन्दाचार्य- दरअसल हमारे यहां सारी समस्या, नकल पर आधारित जीवन जीने की पद्धति के कारण उत्पन्न हुई है। भारतीय संस्कृति ने जल, जंगल, जानवर और जमीन के संरक्षण पर बल दिया है। इसीलिए यह सोच हमारे पूर्वजों के मन में बैठा था कि यह प्रकृति हमारी सभी आवश्यकताओं को पूरा करने का सामर्थ्य रखती है। लेकिन बाजारवाद के हावी होने के बाद प्रकृति का अंधाधुंध दोहन होने लगा, जिसका परिणाम जल, जंगल, जानवर, जमीन के साथ साथ जीवन को भी व्याज सहित चुकाना पड़ रहा है। हम ऐसी व्यवस्था का हिस्सा बन गए हैं जो सामाजिक उत्तरदायित्वों के प्रति उदासीन है और व्यक्तिगत जीवन के सुर्खों के प्रति काफी सजग। हम किसी भी वस्तु का असीमित उपभोग करते समय यह भूल जाते हैं कि इसका इस समग्र वातावरण पर कैसा असर पड़ रहा है। हाल ही के दिनों में वैज्ञानिकों ने आकाश की औजोन परत में बड़ा छेद होने की बात कही है। इसी के कारण एक तरफ तो ग्लोशियर्स पिघलकर समुद्र का स्तर बढ़ा रहे हैं और दूसरी ओर मौसम चक्र बदलने लगा है। हमें सोचना होगा कि हम कैसा जीवन जीये जो प्रकृति के अनुकूल हो।

शास्त्री कोसलेन्द्रदास- जल की जो महिमा वैदिक, पुराणों, उपनिषदों और ऐतिहासिक पाण्डुलिपियों में की गई है। उसमें जल को मनुष्य के लिए अमृत कहा गया है। सैंकड़ों श्रुतियां और मंत्र ऐसे हैं जिनमें जल के महत्व का वर्णन किया गया है। उन सब का विवेचन तो यहां संभव नहीं है लेकिन एक बात में यहां कहना चाहता हूं कि भारत कृषि और ऋषि का देश है। भारत का इसी में नियोजन रहा है कि हम पंचमहाभूतों का संरक्षण करें और उसके महत्व को समझें।

प्रो० मनोहर कालरा- डा० भरत पाठक से जानना चाहेंगे कि पुरातन परम्पराओं और आधुनिक व्यवस्थाओं का संयोजन किस प्रकार किस तरह किया जाए।

डा० भरत पाठक- दरअसल भारत की पुरातन परम्पराएं गांव के विकास से जुड़ी हुई हैं। भारतीय परम्परा में पानी, खेती, पशुधन और उद्योग की व्यवस्था दी गई है। दीनदयाल शोध संस्थान ने चित्रकूट में ग्राम विकास के क्षेत्र में इसी भारतीय



परंपरा को अपनाते हुए ग्राम विकास के अभिनव प्रयोग किए हैं। जिनमें गांव और गाय को केन्द्र में रखकर सारी योजनाएं कियान्वित की गई हैं। हमने खेती को विविधता वाली खेती का रूप दिया है। गांव के पशुधन को संरक्षित करने तथा उनकी नस्ल सुधारने के लिए हम विभिन्न तरह के अनुसंधान कर रहे हैं, इन सब कार्यों को पूरा करने के लिए हमने आधुनिक सुविधाओं और तकनीकों का भी सहारा लिया।

प्रो० मनोहर कालरा- धन्यवाद पाठक जी, आपने बताया कि किस तरह से वित्रकूट जिले के 80 गांवों में दीनदयाल शोध संस्थान ने भारतीय परम्परा के अनुसार ग्रामविकास को साकार कर दिखाया। अब मैं श्री जोगेश्वर गर्ग को आमंत्रित करता हूं कि वे राजस्थान के परिप्रेक्ष्य में अपनी बात रखें।

श्री जोगेश्वर गर्ग- पानी के संरक्षण से हमारा गहरा जुङाव रहा है। आजादी से पूर्व भी जब पानी वितरण की यह आधुनिक प्रणाली नहीं थी, तब भी हमारे पूर्वज पानी का संरक्षण करने की कला जानते थे। वे न केवल पानी के संरक्षण में महारथी थे अपितु पूरे साल उसको किस तरह बरतना है, यह भी वे अपनी संतानों को सिखाते थे। मैं समझता हूं कि पानी के संरक्षण के लिए हमें खुद से ही सीखने की जरूरत है। आधुनिक संसाधनों का उपयोग कर हमें जल संरक्षण को महत्व देना होगा वरना जल संकट सुरक्षा के मुंह की भाँति बढ़ता जाएगा और हम उस पर काबू नहीं पाएंगें। एक बात में विशेष रूप से कहना चाहता हूं कि हमारे पास मानव श्रम की अधिकता है इसका उपयोग हमें जल संरक्षण के क्षेत्र में करना चाहिए।

प्रो० मनोहर कालरा- इसी श्रंखला को आगे बढ़ाते हुए मैं विकास अध्ययन संस्थान, जयपुर के प्रतिनिधि प्रो० एम० एस० राठोड़ को अपनी बात कहने के लिए आमंत्रित करता हूं।

एम० एस० राठोड़- सबसे बड़ी समस्या है कि हमने विकास की अवधारणा का जो रूप तय किया है, वह प्राकृतिक संसाधनों के दोहन पर आधारित है। इस अवधारणा की सबसे बड़ी कमजोरी यह है कि यह प्राकृतिक संसाधनों के संवर्द्धन पर आधारित नहीं है। यह अवधारणा बाजारवाद की जनक है। इसलिए मैं मानता हूं कि यदि हमें मूल समस्या से छुटकारा पाना है तो हमें विकास की अवधारणा के आधार को बदलना पड़ेगा, समाज को दिशा देने वाला बोन्दिक वर्ग अपने इस कार्य में विफल हो गया है, अब यह काम कौन करेगा, यह हम सबके सामने बड़ा प्रश्न है।

प्रो० मनोहर कालरा- अब मैं सर्वोच्च न्यायालय में राजस्थान सरकार के अतिरिक्त महाधिवक्ता श्री अरुणेश्वर गुप्ता को अपने विचार प्रकट करने के लिए आमंत्रित करता हूं।

श्री अरुणेश्वर गुप्ता- मैं समझता हूं कि हमें चरणबद्ध प्रशिक्षण की जरूरत है। किसी भी समस्या से चाहे वह जल हो, पर्यावरण हो, या अन्य कोई समस्या हो सरकार अकेले नहीं लड़ सकती। इसके लिए सरकार नियम कायदे बना सकती है। उन्हें लागू कर सकती है परन्तु जब तक हम स्वयं तैयार नहीं होते, यह सब प्रयत्न बेकार सावित होंगे।

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हमारा प्रयास - सबका हो आवास



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राज्य आयगत योजना



कलब-21 राज आयगत (माडल)



प्रताप एन्कलेव (माडल)

- राज आयगत एन.आर.आई. योजना फेज 1 में 150 बीघा भूमि पर बहुमंजिले आवासों का लक्ष्य।
- प्रताप एन्कलेव में 130 आवासों का निर्माण कार्य प्रारम्भ कर पूर्ण करने का लक्ष्य।
- मुख्यमंत्री की बजट घोषणा के अनुप्रप मासिक किस्तों पर व्याज दर में 1% की कमी।
- देश के ख्यातनाम वास्तुकारों में से 50 से अधिक वास्तुकार सूचीबद्ध।
- लैण्ड बैंक की स्थापना के लिए भूमि अवासि हेतु 65 करोड रुपये का प्रावधान।



मुख्यमंत्री श्रीमती वसुंधरा राजे वीरांगना विहार योजना का शुभारम्भ करते हुए।



मुख्यमंत्री श्रीमती वसुंधरा राजे अन्तर्राष्ट्रीय बस टर्मिनल के शिलान्यास के अवसर पर आवासन मण्डल को 3 वर्ष की डिलीवरी की पुस्तिका का विमोचन करते हुए।



मुख्यमंत्री श्रीमती वसुंधरा राजे द्वारा कलब-21 का शिलान्यास।

* स्व-वित्त पोषित, नीलामी एवं नगद भुगतान पद्धति के आवंटियों को अदेय प्रमाण पत्र आवास के कब्जे के साथ। * कर्मचारी कल्याण हेतु पेन्शन ट्रस्ट का गठन।



मुख्यमंत्री श्रीमती वसुंधरा राजे आवासन मण्डल की लैण्ड बैंक पुस्तिका का विमोचन करते हुए।



द्वारकापुरी आवासीय योजना।



मुख्यमंत्री श्रीमती वसुंधरा राजे द्वारा द्वारकापुरी आवासीय योजना का शिलान्यास।

3 में ग्रोजेक्ट (1) कलब-21 राज आयगत (2) मानसरोवर में अन्तर्राष्ट्रीय बस टर्मिनल (3) एन.आर.आई.द्वितीय फेज

- बाकाया राशि बचूल करने हेतु मण्डल द्वारा आम जन को व्याज में अप्रत्याशित छूट (आर्थिक दृष्टि से कमजोर 70%, अल्प आय वर्ग 60%, मध्यम आय वर्ग 50%, उच्च आय वर्ग 40%)। छूट योजना से मण्डल को 60 करोड रुपए की आय।
- प्रतिदिन की आसन किश्त पर आवास आवेदन।
- राजीव आवासीय योजना के अन्तर्गत प्रदेश में 5500 आवासों का निर्माण। योजना में मात्र रुपये 18-20 विद्युताओं हेतु वीरांगना विहार आवासीय योजना।
- शरीरी क्षेत्र के निर्वाचित योजनाओं हेतु द्वारकापुरी बहुमंजिली आवासीय योजना।
- वाडमें के बाद प्राप्तियों के पुनर्वास हेतु परियोजना के अन्तर्गत 453 आवासों का निर्माण।
- पारम्परिक कलाओं के संरक्षण हेतु राजस्थान सांस्कृतिक धरोहर संरक्षण संस्था की स्थापना।
- मानसरोवर कलोनी, जयपुर में अन्तर्राष्ट्रीय बस टर्मिनल का आगामी 2 वर्षों में निर्माण कार्य प्रस्तावित।
- विस्थापित थड़ी होल्डर्स को सुनियोजित ढंग से बसाने हेतु झलेलाल आधुनिक मार्केट का निर्माण।
- अनिवासी भारतीयों एवं राजस्थानियों हेतु राज आयगत योजना

मण्डल द्वारा समय-समय पर राज्य के विभिन्न शहरों में प्राइम लोकेशन पर आवासीय, व्यावसायिक भूखण्डों, निर्मित दुकानों आदि का आयोजित भव्य नीलामी में भूखण्ड खरीद कर विकास में भागीदार बनें।

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मकान ही नहीं - घर भी बनायेंगे